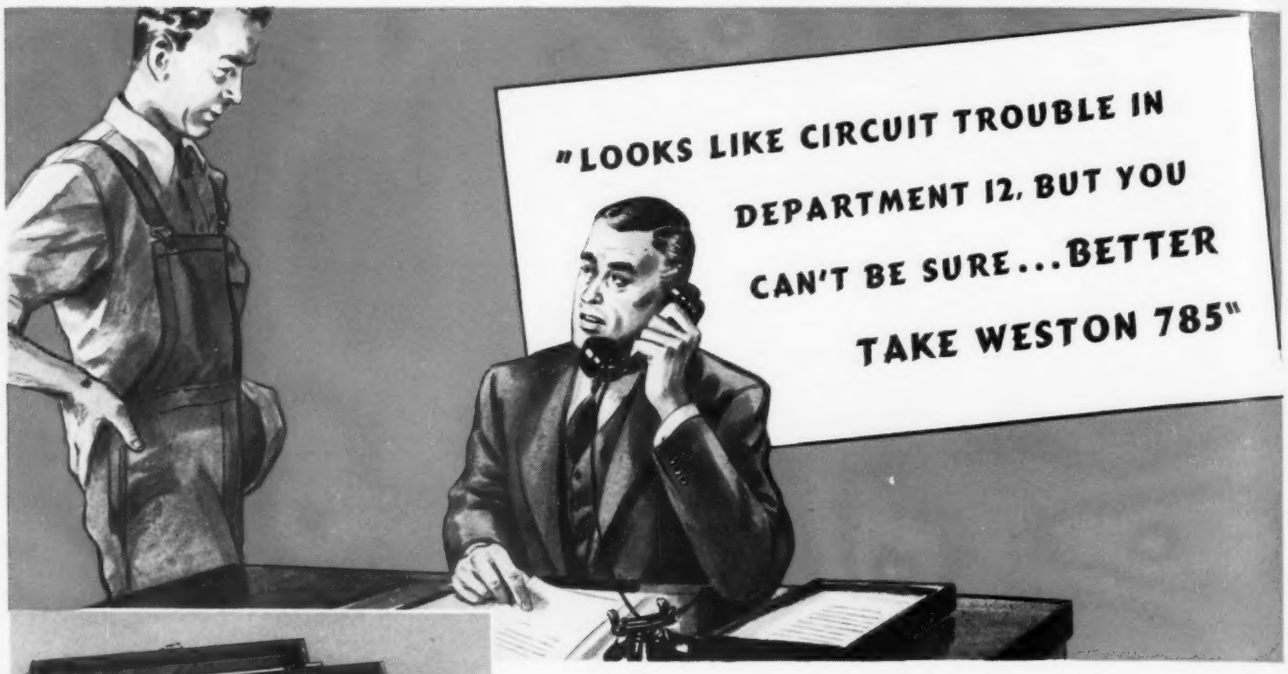
Electrical World
MARCH 8, 1941
EVERY HOME WITH Electric Light SHOULD HAVE AN
Electric WATER HEATER
HERE'S A STAR SALESMAN'S RECIPE FOR COOKING UP Electric Range Sales
THE PRINCIPLES OF MODERN KITCHEN PLANNING
One Penny WILL CARRY THIS LOAD FOR YOU
AT HALF THE COST!
NEW RECORDS IN 1941
RECORD YEAR IN 1940
1940 IS THE YEAR TO BUY YOUR NEW ELECTRIC REFRIGERATOR
The HOME OFFICE
IT PAYS DIVID
"I'M GIVING YOU FOLKS HERE THE LOW-DOWN HOW TO Make it Easy!"
YOUR EYES NEED Better Light Better Sight
HOW TO SELL QUALITY APPROVED ELECTRIC ROASTERS!
11th APPLIANCE SALES SURVEY



WESTON MODEL 785
Industrial Circuit Tester

VOLTAGE RANGES

DC Volts—0-1/10/50/200/500/1000 volts—20,000 ohms per volt

AC Volts—0-5/15/30/150/300/750 volts—1000 ohms per volt

CURRENT RANGES

DC Current—0-50 microamperes, 1/10/100 milliamperes, 1 ampere and 10 amperes

AC Current—self-contained ranges 0-.5/1/5/10 amperes. (Higher ranges with an external current transformer.)

OHMMETER RANGES

0-3000, 0-30,000, 0-300,000 ohms, 0-3 megohms, 0 to 30 megohms (self-contained batteries).

...this one *multi-purpose* instrument handles 90% of plant emergency calls!

Here's a maintenance chief who handles "trouble" in an efficient, practical manner. True, he has a complete set of standard WESTON electrical instruments for periodic maintenance checking. But on emergency calls, where quick action is needed, and where the cause of the trouble is unknown, he uses the WESTON Model 785 Industrial Tester... a multi-purpose instrument with voltage, current and resistance ranges specifically for this service. For with the compact Model 785 alone, he can check motor and control circuits... lighting circuits... sensitive relay circuits... and even communications and electronic circuits. And in addition to wide adaptability, Model 785 also provides the ruggedness and dependable accuracy which is typically WESTON. Remember, too, that Model 785 is but one of many time-saving, cost-cutting, *multi-range, multi-purpose* instruments in the WESTON line. Why not have all the facts? Phone your nearest WESTON representative, or write to... Weston Electrical Instrument Corporation, 578 Frelinghuysen Avenue, Newark, New Jersey.

Laboratory Standards . . . Precision DC and AC Portables . . . Instrument Transformers . . . Sensitive Relays . . . DC, AC, and Thermo Switchboard and Panel Instruments.

WESTON

Specialized Test Equipment . . . Light Measurement and Control Devices . . . Exposure Meters...Aircraft Instruments... Electric Tachometers...Dial Thermometers.

FOR OVER 52 YEARS LEADERS IN ELECTRICAL MEASURING INSTRUMENTS

Electrical World

FOUNDED IN 1874 • READ BY ELECTRICAL MEN FOR 67 YEARS

A. E. KNOWLTON.....*Associate Editor*
HENRY G. DOOLEY.....*Associate Editor*
G. F. WITTIG.....*Statistical Editor*
E. DALTON WHITE.....*News Editor*
CHARLES DE VORE.....*Assistant Editor*
E. M. GLENNON.....*Assistant News Editor*

BRANCH OFFICES
L. W. W. MORROW.....*Western Editorial Director*
D. T. BRAYMER.....*Western Editor*
H. S. KNOWLTON.....*New England Editor*
WAYNE SNOWDEN.....*Pacific Coast Editor*
PAUL WOOTON.....*Washington Correspondent*

FRANK R. INNES.....*Managing Editor*

S. B. WILLIAMS.....*Editor*
W. K. BEARD, JR.....*Manager*

March 8, 1941

Contents

Vol. 115, No. 10

Annual Report of Utility Load Building in 1940..... 67
HENRY G. DOOLEY, *Associate Editor*

Utility and dealer sales of lighting devices and appliances reach higher levels. Increase of 9.1 per cent achieved with 17 per cent less money. Highest usage in history

Electrical Features of Claytor Hydro Plant—I..... 56
PHILIP SPORN and H. A. KAMMER, *American Gas & Electric Service Corporation*

Surge Absorbers Avert Transformer Burnouts..... 60

New Form of Insulation Simplifies Splicing..... 62
C. P. XENIS and F. B. THOMSON, *Consolidated Edison Company of New York, Inc.*

Pattern of Station Auxiliary Drives Is Changing..... 64
J. C. CUNNINGHAM, *Westinghouse Electric & Manufacturing Company*

Socket Meters Ganged in Breakaway Panels..... 75

Maximum Availability Aim of Switch-House Design—II..... 76
H. W. EALES and H. L. HOEPPNER, *Public Utility Engineering & Service Corporation*

Carter Field on Washington Events..... 82

News of the Week..... 83

Editorials	55 and 80	News About People	130
Field Operating Practices	92	Manufacturing and Markets	138
Industrial Engineering	98	Legislation	144
New Engineering Ideas	106	Recent Rate Changes	147
Load Building	112	Rural Allotments	148
New Equipment	124	Sales Opportunities	150

Index of Advertisements..... 160

McGRAW-HILL PUBLISHING COMPANY, INC.

JAMES H. McGRAW, Founder and Honorary Chairman

Electrical World—Published weekly. Price 25 cents a copy. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 330 West 42d Street, New York, N. Y. Subscription rates: In the United States, Mexico, Central and South American countries, $5 a year, $8 for two years, $10 for three years. Canada, $5.50 for one year, $9 for two years, $11 for three years (Canadian money at par) Great Britain and British possessions, 54 shillings for one year, 108 shillings for three years. All other countries $9 for one year, $18 for three years. Entered as second-class matter November 16, 1936, at Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in U. S. A. Contents copyrighted, 1941, by McGraw-Hill Publishing Company, Inc. Branch Offices: 520 North Michigan Avenue, Chicago; 68 Post Street, San Francisco; Aldwych House, Aldwych, London, W. C. 2; Washington, Philadelphia, Cleveland, Detroit, St. Louis, Boston, Atlanta, Ga.

Publication Office
99-129 North Broadway, Albany, N. Y.

Editorial and Executive Offices
330 West 42d Street, New York, N. Y.

JAMES H. McGRAW, Jr.....President
HOWARD EHRLICH.....Executive Vice-President
MASON BRITTON.....Vice-Chairman
B. R. PUTNAM.....Treasurer
D. C. McGRAW.....Secretary
J. E. BLACKBURN, Jr.....Director of Circulation

Member A.B.P. Member A.B.C.
Cable Address McGRAWHILL, New York

A McGRAW-HILL PUBLICATION

For OKONITE Insulation —the World's Finest Rubber

The Okonite formula provides a dense, uniform, tough insulation containing not less than 30% by weight (over 60% by volume) of new Wild, Up-river Fine Para rubber, the *only* rubber ever used in Okonite Rubber Insulation. Okonite never contains low grade or cheaper rubbers, reclaimed rubber, rubber substitutes, or plantation rubber.

Recognized authorities state that Wild, Up-river Fine Para rubber has better aging qualities, consistent uniformity, greater original toughness and higher resistance to solvents than plantation rubber. These characteristics are undoubtedly due to the fact that the rubber is obtained from virile, sturdy trees that have survived the process of natural selection in the jungles of the Amazon.

Para rubber reaches the Okonite factory in the form of biscuits, which are sliced, ground and washed to remove all impurities and foreign matter. The thoroughly cleansed rubber is then rolled into sheets and suspended for at least 30 days in dark drying rooms. When these operations are completed, the rubber is ready to be used in making Okonite insulation.

The exceptionally long life of Okonite rubber insulated wires and cables proves the wisdom of using Wild, Up-river Fine Para rubber.

THE OKONITE CO., PASSAIC, N. J.
Offices in Principal Cities

5 FOUNDATIONS OF OKONITE QUALITY

1. Made only with Up-river Fine Para rubber carefully washed and dried
2. The Okonite formula is proved by long use rather than accelerated tests
3. Conductors perfectly centered by the Okonite strip-insulating process
4. Uniformly vulcanized under pressure in a continuous metal mold
5. Thoroughly tested and inspected throughout the manufacturing process

Okonite's Okoloy coating on conductors eliminates corrosion

OKONITE

OKONITE

INSULATED WIRES AND CABLES SINCE 1878

Trained Men

Men, men, men, give us men—engineers, managers, draftsmen, trained men, men to train. That is the cry of industry, louder in places even than the cry for raw materials. Yet much of it need not have happened, for it is but the fruit of one of industry's worst follies.

For years young engineering graduates tramped the streets looking for work. There were no jobs for them in the field for which they had been educated. Today they are in other occupations. They could not wait. Those who have ability have made a place for themselves, and even if they would come back they cannot afford to make the change at the salaries they would have to take.

It is only within the last three or four years that engineering graduates have found opportunities enough in their profession to take care of most of them and, of course, this year there are not enough graduating engineers.

The same situation exists with respect to draftsmen and skilled mechanics, with the result that today, when industry needs good men the most, it must be satisfied with what it can get.

Because it takes two years to build a turbine we order ahead and keep a reserve. Yet when it comes to man-power, which takes much more time to train, the tendency is to wait until the need arises.

And when an emergency such as this arises so great is the demand and so small is the supply that employers are forced to resort to expedients. Training periods are shortened up to months or weeks and every likely applicant is given an opportunity. As a result not infrequently machines are damaged by these inexperienced hands, machines that are almost as hard to get as a free ticket to a movie premiere.

Engineering colleges are talking of optional three-year courses, in order to supply men to industry and some of these short courses will undoubtedly start this year. Industry that for six years neglected the young engineering graduates is now asking them to reduce the time for their education from four to three years.

The worst of it is that these expedients are not going to produce trained men or skilled operators. We are still going to need experienced men on whom to build for the future. For that reason, in spite of the abnormal demands being made by defense, the training of the young engineers who are coming out of college this year and next must not be sidetracked.

A large part of the crop of 1930-1936 was pretty well scattered to the four winds. If now we sacrifice the training of the crop of 1940- through the emergency, we may find our progress in the years to come materially slowed down.

Those who lately have wished they had maintained training programs during the depression have in these times of greater earnings an opportunity to insure against temptations of unwise economies in the years ahead. We insure peak operation by all forms of material investment. If today's lesson has been truly learned we shall begin to make the necessary investment in a program of man building.

Under stress, production can be turned out in record time, but only good training and adequate experience can develop competent engineers and skilled mechanics.

Electrical Features of Claytor Hydro Plant—I

Design and construction details of power house, generating facilities and transformer switching station of 83,333-kva. plant on New River in Virginia

PHILIP SPORN and H. A. KAMMER,† American Gas & Electric Service Corporation, New York*

ON THE New River in Virginia (recently declared navigable by the U. S. Supreme Court) is the new 104,000-hp. Claytor development of the Appalachian Electric Power Company. It comprises four Francis type turbines working at 110-ft. head to utilize the flow and 12,000,000 kw.-hr. storage capacity of the pond formed behind the 1,150-ft. dam. Average estimated flow is 3,000 cu.ft. per second, with a July, 1916, maximum of 170,000 and a 1940 maximum of about 200,000.

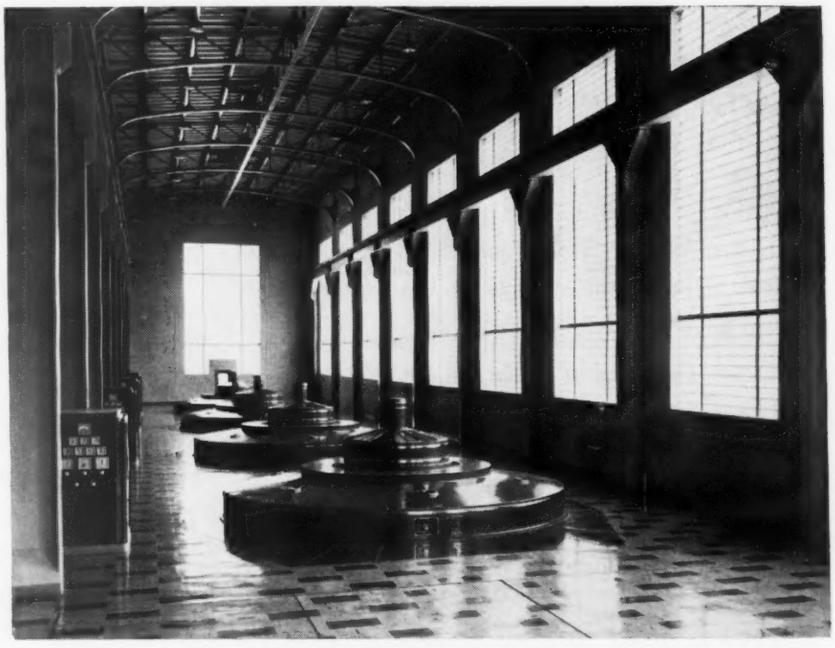
(The hydrology, geology and dam-construction technology of the development are being related in a companion article by Messrs. Sporn and Kammer in *Engineering News-Record*, March 13, 1941—EDITOR.)

To connect the reservoir and intake structure at Claytor hydro plant with the turbines 16-ft. diameter steel plate penstocks were used, employing riveted connections throughout. No expansion joints were installed because they were thought to be unnecessary as sufficient flexibility exists on account of both the position and the length of the penstock. The steel penstocks are exposed within the power house for their entire length. As a means of preventing moisture, due to condensation, from becoming a nuisance two coats of granulated cork covering were applied to the outside of the steel pipes; the results to date have proved this to be a satisfactory arrangement.

The intake for each of the waterwheels installed in the power house was provided with two headgates, one a weighted flat gate with wheels and the other a Broome gate (Philips and Davies type).

Headgates are electrically operated, with the control so arranged that the Broome gate must be fully open before the flat gate can be raised, and in closing the flat gate must be fully closed before the Broome gate can be lowered. The headgates are controlled both from the main switchboard in the power house and from the individual hoisting mechanism housings on top of the intake bulkhead. At the main switchboard push-button control is provided for only emergency closing of the headgates, while complete control, as previously described, is installed in the hoisting mechanism housing.

A log boom has been provided upstream from the intake bulkhead and at the riverward end of it a trash gate has been installed between the intake bulkhead and the first spillway gate. This trash gate is of the flat type with wheels. It is electrically operated so that when it is desired



GENERATOR ROOM elicits favorable comment from visitors
Buff-colored brick. Asphalt tile (8x12-in. checkerboard, alternating marbleized blue and white) for floor covering. All exposed structural steel painted buff. Equipment, "stratosphere" blue enamel and trimmed with stainless steel bands.

* Vice-president and chief engineer.
† Construction engineer.

to pass trash over the spillway it can be lowered in order that floating debris can be skimmed from the top of the reservoir.

The substructure of the power house up to the generator floor elevation was constructed of concrete without any structural connection to the intake bulkhead, in order that any movement of the latter would not induce cracking in the power house substructure. Vertical contraction joints were located between each of the units, extending from the rock foundation to the generator floor elevation.

Generator Stator Depressed

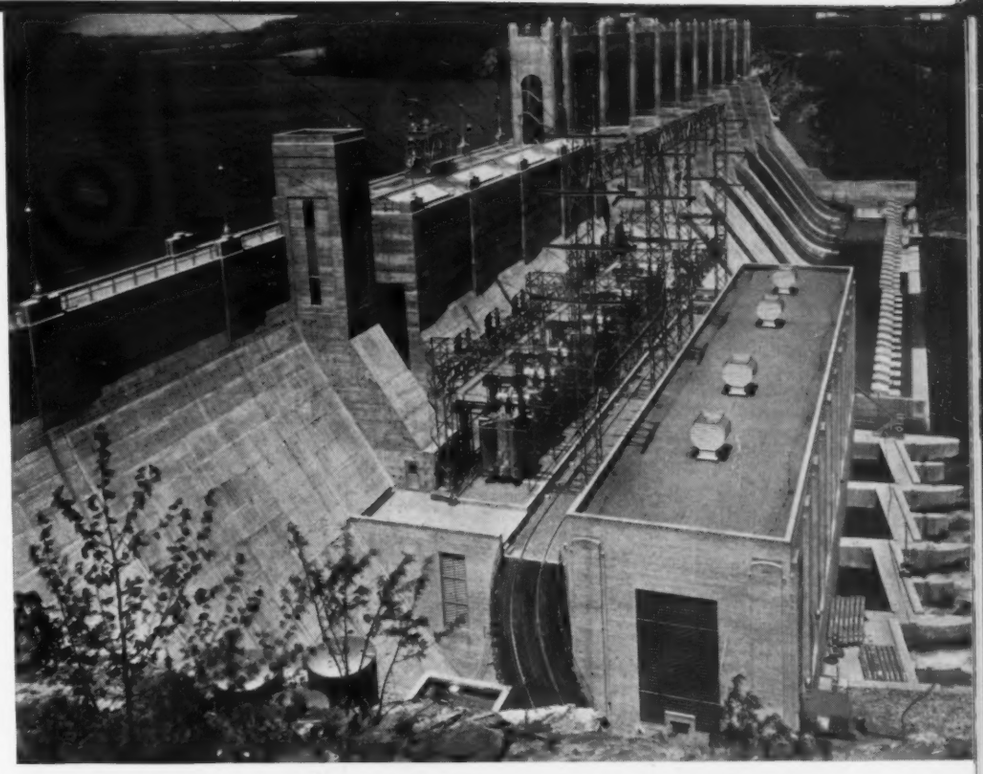
Elevations of the floor and roof of the generator room were determined by the space required for assembling the generating units and servicing the power transformers, also to avoid duplication of crane facilities. A study of this problem resulted in depressing the generator stator below the finished generator floor elevation, with a consequent saving in the height of the superstructure. To facilitate removing the core from a power transformer a hatchway was provided in the generator floor at the north end of the power house. Through this hatchway the assembled unit is lowered so that it rests on the turbine room floor, after which the core is pulled out of the tank. For handling the equipment a 120-ton electrically operated crane was installed which was equipped with a 10-ton auxiliary hoist.

Architecture

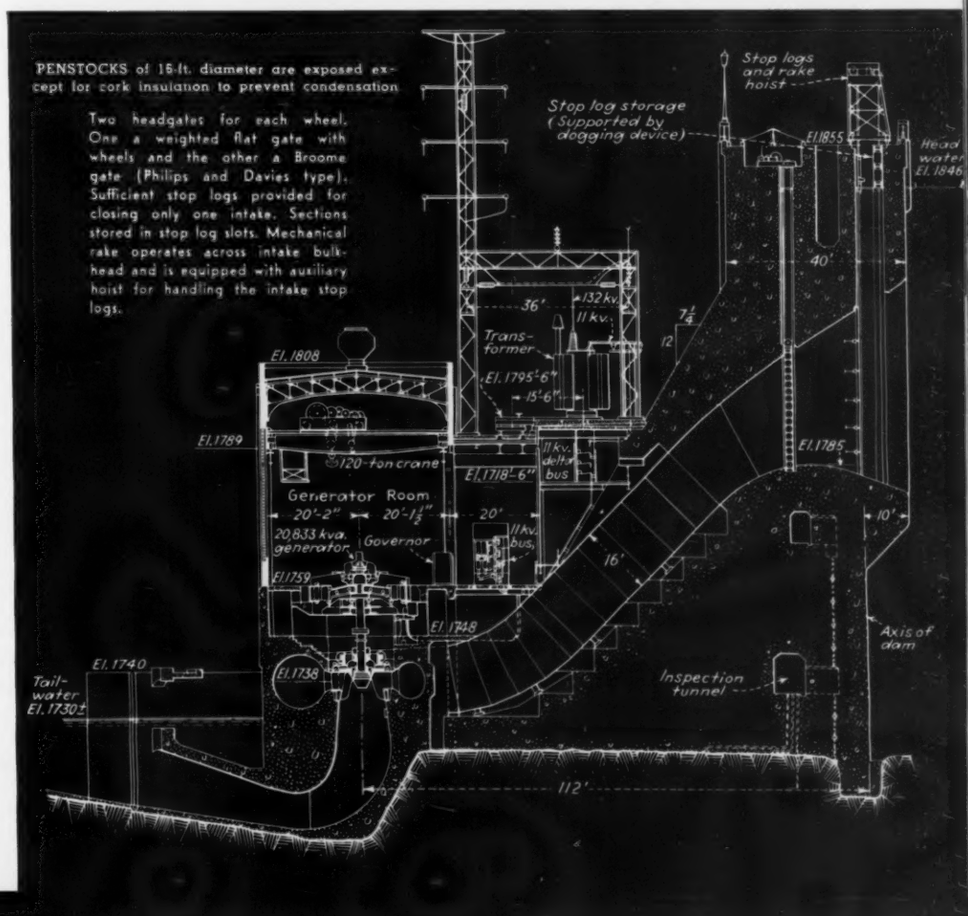
As decided from experiences elsewhere on the American Gas & Electric Company central system, the power house walls above the generator floor (elevation 1,759) are of brick masonry construction. To blend these walls properly with the concrete dam a sand cement brick was selected for the exterior facing. Instead of the conventional steel window sash, glass brick was used in all of the openings in the exterior walls not only because of its superior appearance, but also to keep the heating load of the power house at a minimum.

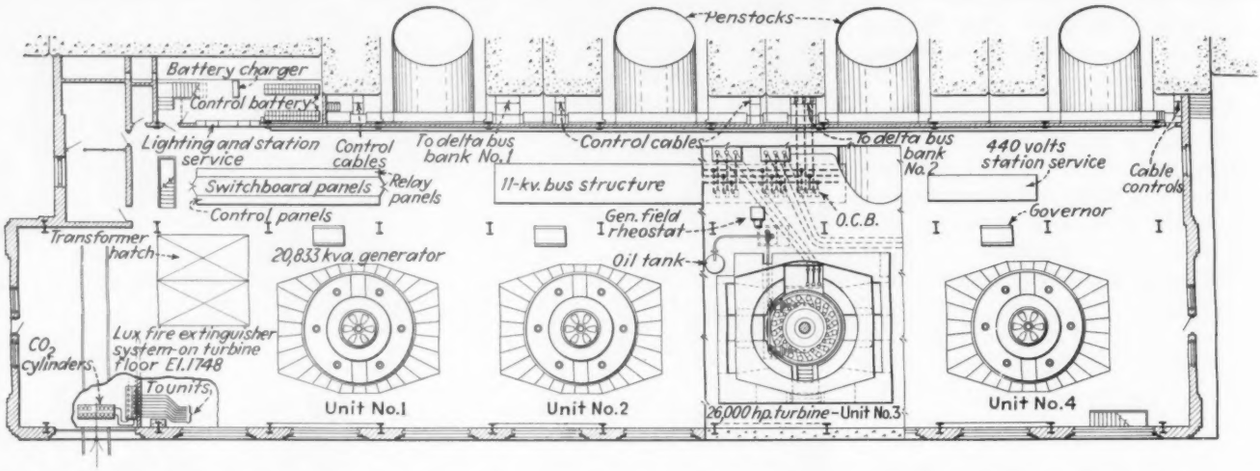
Considerable thought was given to the possibility of the contraction joints in the concrete substructure producing cracks in the masonry wall located immediately above it. Examination of other plants constructed by the company where similar conditions prevailed showed that this had not happened, and therefore reinforcing steel was eliminated in the brick masonry wall over the top of all contraction joints except one. As an experiment, reinforcing steel was placed across one of the contraction joints in the upper one foot of the concrete substructure, to try to limit the opening of the joint. After approximately one year since construction of these walls no cracking has developed in either case.

For ventilating the power house, intake louvers, which supply fresh air to the generator room, have been installed in the north and south end building walls. The fresh air required for the turbine room is furnished through louvers opening into the elevator shaft, and also into the



NEW RIVER dammed for 104,000 hp. (83,333 kva.) at four-unit Claytor plant





FOUR 26,000-hp. Francis type turbines and penstocks arranged 44 ft. apart; 11,000-volt switching compartments and control boards are both located on generator floor

space between the intake bulkhead and the generator room. Heated air is exhausted through four large streamlined fan-type ventilators located on the roof of the generator room.

Considerable attention was given to the treatment of the interior of the power house above the generator room floor elevation to obtain an attractive and harmonious appearance.

Hydro Units

Study of the Appalachian Electric Power Company's generating requirements demonstrated¶ that it would be best to develop the Claytor hydroelectric power development for a condition of neither strictly peak load nor relatively firm base operation.

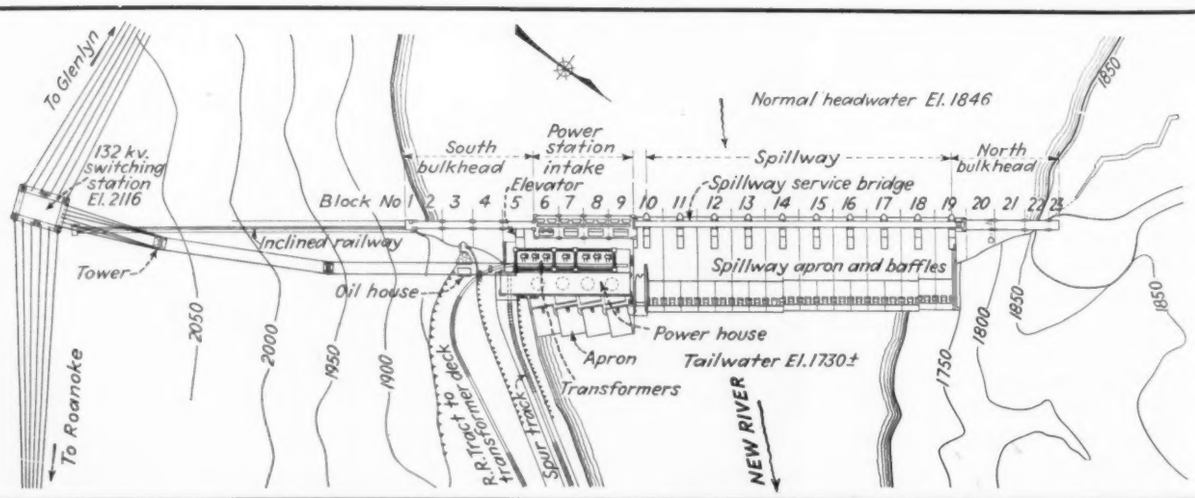
Four Francis type water turbines, each rated at 26,000 hp. when operating at an effective head of 110 ft. with a speed of 138.5 r.p.m. were installed. The guide bearings are of the babbitted sleeve type. To minimize leakage through the wicket gates when the units are not in operation rubber seals were provided at the top and bottom of each gate. The scroll cases are of riveted steel plate construction. A compressible filler was placed between the top of the scroll cases and the concrete substructure to prevent any cracking of the turbine room floor which might be caused by expansion of the scroll cases due to water pressure.

Each turbine is provided with a 130,000-ft.-lb. Woodward cabinet type governor, in which the actuator, pumping unit, sump tank, piping and restoring mechanism are installed in one compact unit. At one end of each governor cabinet a panel is located on which is mounted the gauges indicating oil pressures and gate position. The actuators are equipped with motor-driven flyballs, safety stop, synchronizing attachment, governor oil pressure system, pressure and receiver tanks, and motor-driven oil pumps.

Generators

Connected to each of the turbines are electric generators, each rated 20,833 kva., 11,000 volt, three phase, 60 cycle, 138.5 r.p.m., and each is provided with a direct connected 250-volt main exciter and a 250-volt pilot exciter. To provide for operation as a synchronous condenser, each gen-

¶ See *Engineering News-Record*.



TRANSFORMER and automatized switching stations are separate and on different elevations. An inclined tramway with capacity of 1,500 lb. connects the two elevations and enables delivery to substation site of equipment pieces like bushings, insulators, etc., received over the railroad spur

erator has an overexcited capacity of 13,200 kva. at 0 per cent power factor at rated voltage and an underexcited capacity of 18,333 kva. at 0 per cent power factor at rated voltage.

The generators are of the umbrella-type frame construction, equipped with self-oiled Kingsbury type thrust bearings, and water-cooled combined guide and thrust bearings, the latter located immediately below the generator rotor. The WR^2 of the rotating parts is 10,233,333 ft.^{2}lb.

Ventilation of the generators is accomplished by using two surface type coolers for each unit. They are located within the generator foundation and fed with river water by a gravity system. The ventilating system of the generators operates during the summer time as a closed system. In the winter time part of the air heated by the generators is bled from the machines and used to heat the power house. In the offices, located at the south end of the generator and turbine rooms, electric unit heaters have been provided as an auxiliary source of heat. This same method of heating the power house was used for the London, Marmet and Winifield developments constructed on the Kanawha River some years ago, where it has proved very satisfactory.

More than ten years prior to the construction of the Claytor development, when the 132-kv. transmission system of the Appalachian Electric Power Company was projected, a line was built connecting Roanoke, Va., to one of the larger steam plants of the system located at Glen Lyn, Va. This line was laid out to pass as closely as possible to the then known location of the contemplated dam. In the later design of the plant it was found that if the high-tension yard were located properly not a single additional line tower would be needed; in fact not even a single tower location would have to be changed. This, coupled with a desire to provide ample room for future expansion of switching facilities, determined the location of

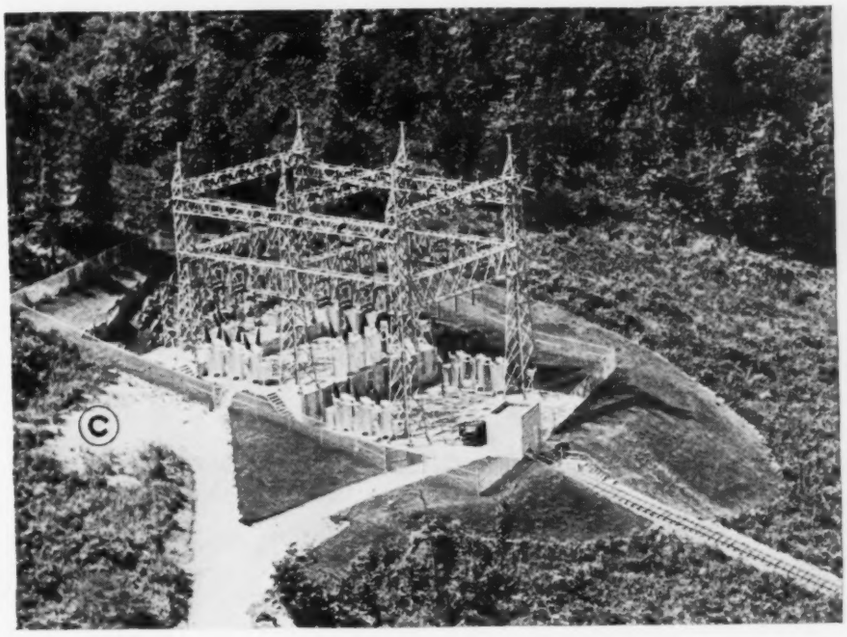
[*Continued on page 151*]

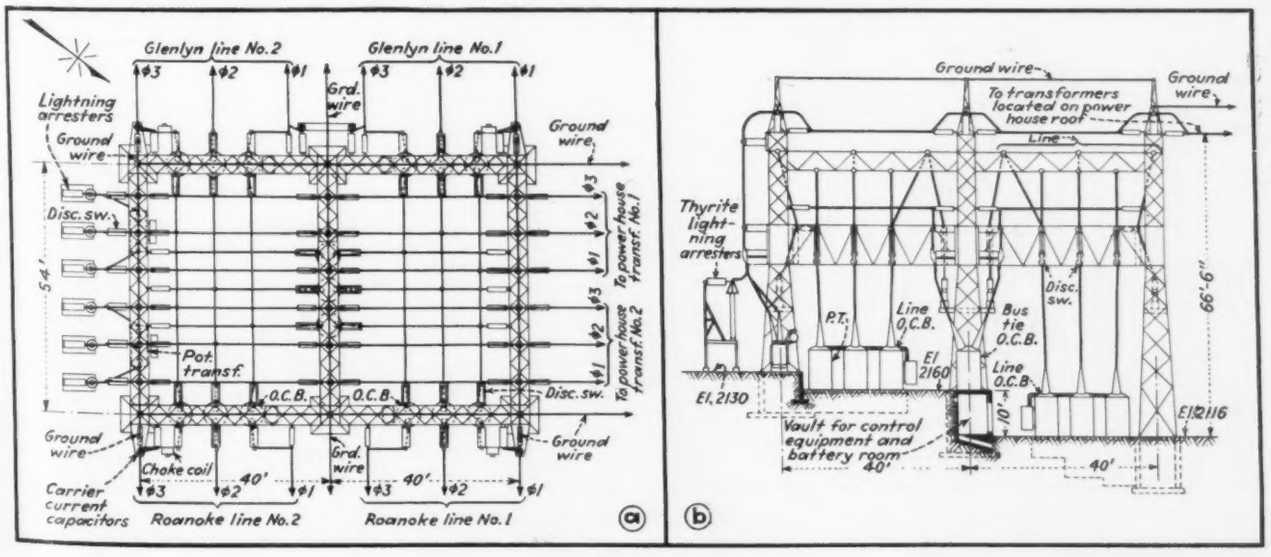
LAYOUT of 132-kv. switching station

(a) Simple bus arrangement switches four 132-kv. lines and two 132-kv. transformer banks through five 132-kv. oil circuit breakers. Bus lightning arresters provided on each bus section and three ground wires over lines entering each side of station.

(b) Structure and equipment located between towers on existing line on three different elevations. Line dead-ended on structure, each side, for horizontal tension of 8,650 lb. class B loading. The six leads and two ground wires connecting the switching structure with the transformer structure on the power house roof were installed at a horizontal tension of 4,100 lb. class B loading per wire.

(c) Rigid frame design for heavy line loading. Foundation conditions were excellent and permitted fullest utilization of rigid design with considerable saving in steel costs as compared to conventional non-rigid design. Corrosion, fabrication and connection details usually require a certain minimum size of member for the latticed trusses which is in excess of the load requirements when non-rigid connections are used. Also the rigid design greatly reduced the size of leg angles for the towers and put to work the excess material available in the trusses.





Surge Absorbers Avert Transformer Burnouts

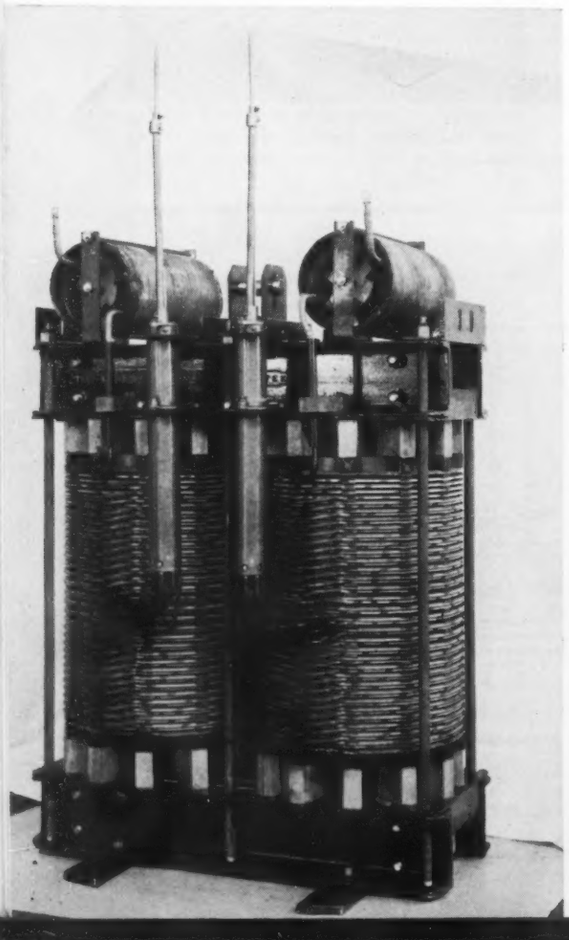
Canadian power systems experience minimized burnouts and fuse blowing with series form of wave-flattening protection

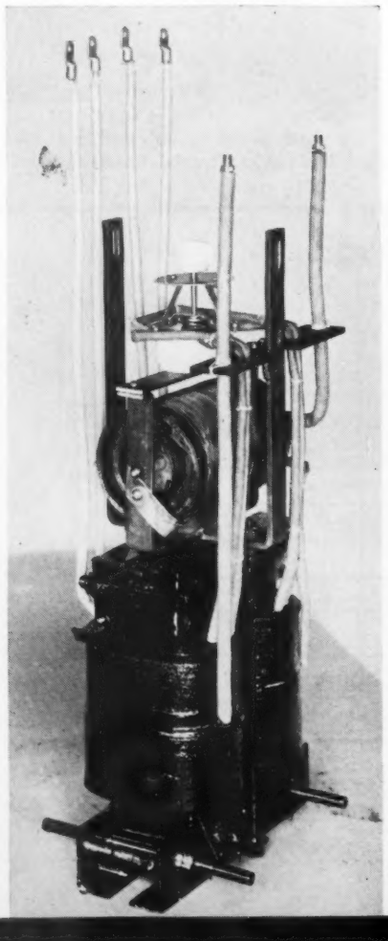
APPROACH toward protection of power transformers seems to differ in British territory, particularly Canada, materially from the forms of protection generally adopted in this country. There the utilities and the industrials (largely mining companies with transmission and distribution systems) have rather extensively adopted a series form of wave-flattening protection, whereas American practice has taken the shunt path for relief of and from lightning. Why is it that the trend in approach is so different north and south of that famed undefended border? What experience have Canadian power systems had that defend their acceptance of the series-installed surge absorber? Why rely on a balanced arrangement of inductance and capacitance to disarm an oncoming wave rather than deflect the charge to ground?

Believing that the facts and the conclusions of Canadian power engineers would throw some light on this notable difference, a query was sent to certain major users among the 150 utilities, thirteen mining companies and 36 industrials known to have applied surge absorbers and surge-absorber-protected transformers. Replies were received in detail from systems having well over 1,000 transformers with built-in absorbers and nearly 300 separate absorbers. The replies indicate a high degree of satisfaction with the device and the protection it affords to equipment.

This is well borne out by the statement of E. Gray-Donald, general superintendent of Quebec Power Company, that "we have saved ourselves a great deal of money and trouble and have improved service by installing either external surge absorbers on existing transformers or buying transformers with built-in surge absorbers . . . one of the fine things about surge absorbers is that they still work well on poor or non-existent grounds . . . we are enthusiastic boosters . . . our enthusiasm is based on 100 per cent satisfaction." Others have tried them and expanded the applications over the last five or seven years on the basis of results obtained.

TWO 500-kva., 11-kv. surge-proof transformers with 45-amp., 12-kv. surge absorbers (left). Built-in surge absorber for up to 10 kva. on 60 cycles or 5 kva. for 25 cycles (right)



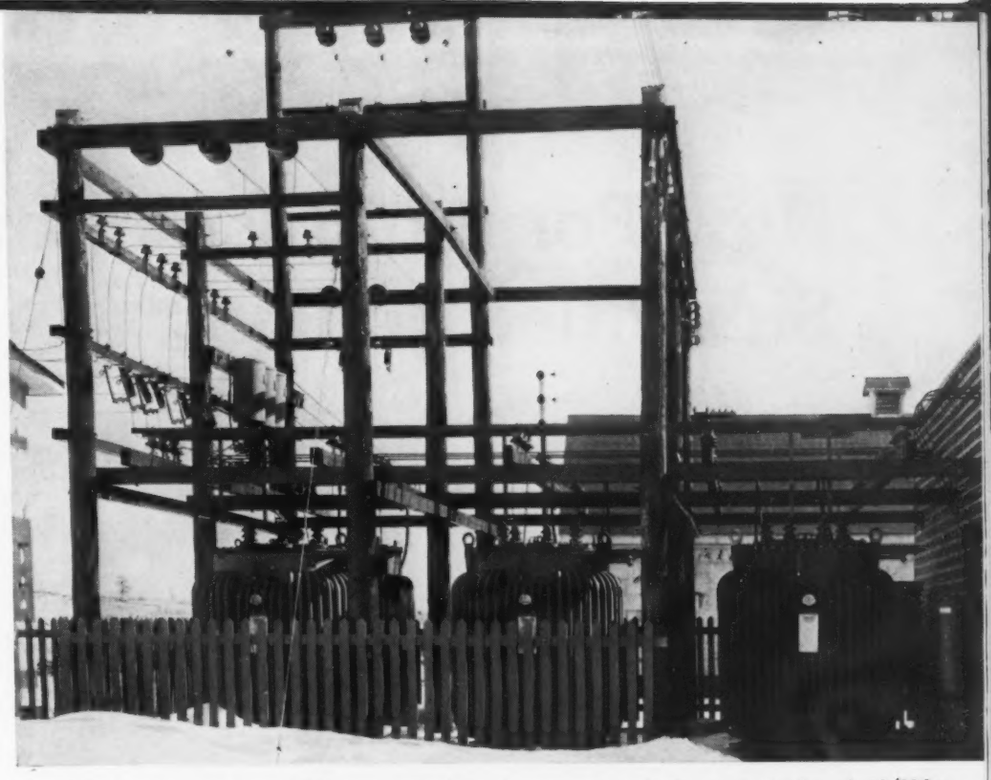


Ground Resistance

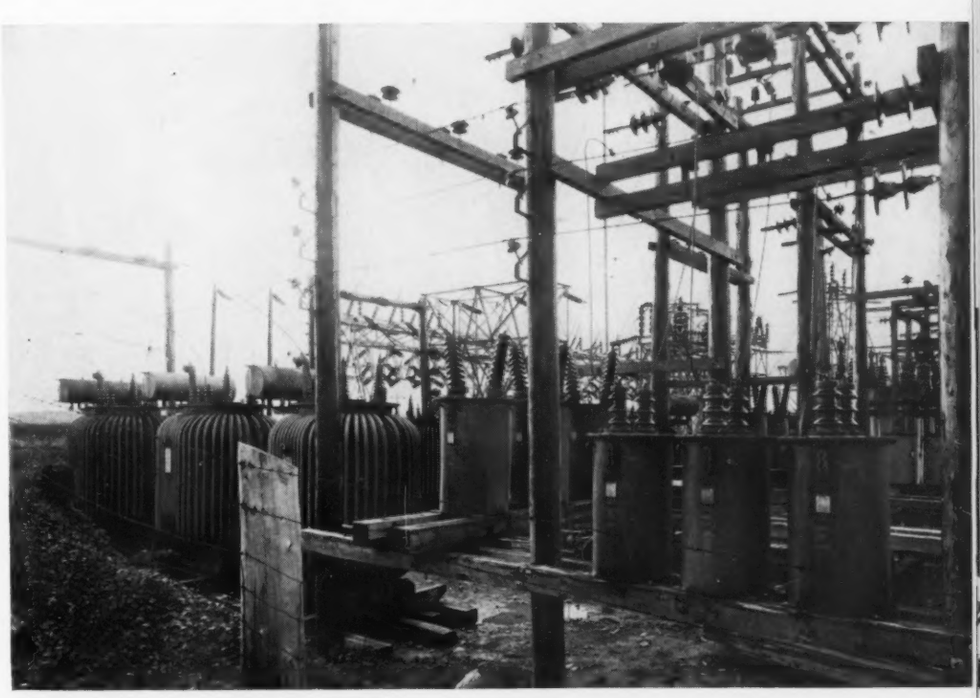
Dry sand covers the entire district of the small Delhi (Ont.) Hydro-Electric System. All the 48 transformers, reports Ray Pfaff, are equipped on the line side of the common neutral 8/4.6-kv. grounded system. It is almost impossible to get a ground of less than 100 ohms. Previously the company lost one or two transformers every season. Since the change "we haven't lost a transformer or a transformer fuse from lightning. We have had several direct lightning hits on our line . . . pole

was struck and badly splintered, but we lost no transformer nor fuses. . . . I find this form of protection the best we can get. A "real advantage" is "the very simple pole mounting. . . . It is a clean, neat looking job . . . cost of surge absorber and any form of arrester is about equal here, taking into consideration erection time and all."

Another company with considerable rural distribution which has been using external surge absorbers since 1932 says: "About 85 per cent of our fuse blowing is at transformers under 5 kva., showing that the size of fuse is a factor. The twelve transformers with built-in absorbers have had one fuse blown. Surge absorbers have proved to be much superior to arresters where high ground resistance is encountered, as in this area."



FERRANTI surge absorbers (150 amp. rating) in foreground protecting two banks of 12/33-kv., 750-kva. transformers of Beattie Gold Mines



THREE 500-kva., 11/22-kv. transformers with internal surge absorbers. On the structure are three pole-type absorbers separately installed to protect three 200-kva. standard transformers in the rear

Failures Reduced

Still another company concludes that there is "decided reduction in transformer failure as compared with transformers protected by arresters."

In answers to queries as adapted for the summary companies will be identified by letters as follows:

A. Quebec Power Company, Quebec, Que.
B. New Brunswick Electric Power Commission, St. John, N. B.
C. Delhi Hydro-Electric System, Delhi, Ont.
D. Canadian Niagara Power Co., Fort Erie, Ont.
E. Beattie Gold Mines, Ltd., Duparquet, Que.
F, G. Unidentified.

Range of Voltage—On what range of voltages do you apply surge absorbers to transformers?

A. Up to 23 kv., but generally on 2.3, 6.9, 11 and 13.2 kv.
B. "Many hundreds" in both 2.3 and 6.9 kv. classes.
C. 4.6 kv.
D. 2.3 and 4.6 kv.
E. 12 to 33 kv.
F. 13.8 kv. delta and 24 kv. star.
G. All rural 2.3/4.1 kv. and one 13.2 kv. bank.

Transformer Size—For what maximum and minimum kva. ratings?

A. On 23 kv. three separate 400-amp., 25-kv. surge absorbers protect two 7,500-kva. banks. On 13.2 kv., 5 to 25 kva.; on 11 kva., 37½ kva.; on 69 kv., 1 to 50 kva.; on 2.3 kv., 3 to 100 kva.
B. Majority are 3 kva.
C. 3 to 100 kva.
D. 5 to 37.5 kva.
E. Up to 750 kva.
G. All rurals 0.6 to 25 kva. and one 100 kva. 13.2 kv.

Supplementary Protection—What supplementary fusing, grounding, etc., are used in connection with surge absorber protection?

A. No special fusing or grounding. Surge absorbers are connected to whatever grounds are available, but no checks are made to determine ground resistance or efforts made to keep it below any particular figure.
C. None.
D. Two primary fuses, secondary neutral grounded.
E. Overhead ground wire on transmission line.
F. No change in fuse size, fuse placed on line side absorber, absorber case grounded.
G. Fuses ahead of absorber at all transformers. Absorbers grounded to three rods and, where possible, to common neutral.

Transformer Failures—How many transformers have failed because of failure of surge absorber to protect

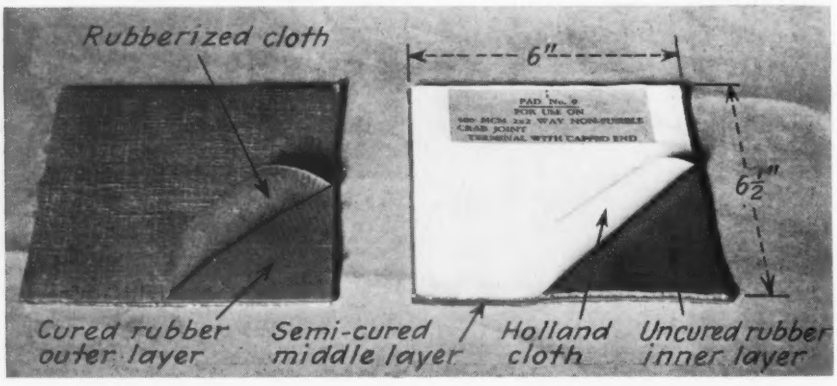
[*Continued on page 158*]

New Form of Insulation Simplifies Splicing

Insulating pad for distribution splices demonstrates substantial advantages over conventional taping methods — Composed of three layers of rubber with varied degrees of cure

C. P. XENIS and F. B. THOMSON, Consolidated Edison Company of New York, Inc.

FIELD EXPERIENCE over nearly a year with a new form of multi-layer rubber insulation, called the insulating pad, shows that the pads are very simple to install, since they are not bulky and are easily handled, even when the user is wearing rubber gloves and leather protectors. This pad is a unitary piece of insulation composed of three distinct layers of rubber, each subjected to different degrees of curing during manufacture. Its cost is approximately the same as for tape and the construction of joints is materially simplified by its use.



INSULATING PAD is made up of three layers of rubber having varying degrees of cure and covered with protective cloth. Pad shown is for use on 500,000-circ.mil cable connection. Seven sizes have been standardized on for use in distribution splicing work

CROSS-SECTION of joint insulated with ruber insulating pad shows excellent bond obtained. This is the cross-section of a joint newly made; after a few days the joint takes on a more nearly circular shape

EASE OF INSTALLATION is a feature of the insulating pad, even when the user is wearing rubber gloves and leather protectors. Here pad is being applied to a tapered joint. Facing page shows procedure for applying pad to straight joint

Difficulties in Taping

While the use of pre-insulated "crab joints"* has materially reduced the amount of "taping" that must be done in splicing low-voltage distribution cables, it has still been necessary to tape straight joints and the connections of individual cables to the crab joint. By using semi-cured tape material the necessary adhesive properties are obtained and the applied layers do fuse together to form a uniform insulating mass. However, in order to apply a sufficient amount of insulation over a joint on a fairly large conductor as, for example, No. 4/0 or 500,000 circ.-mil, this insulating procedure becomes slow and tedious, especially if only small spaces are available between cables in an underground manhole or service box.

Then, too, the physical properties of the taped joint are relatively inferior to those of the cable insulation, since the tape in semi-cured form does not possess optimum physical properties and resistance to deteriorating influences such as oxidation, moisture absorption, resistance to the action of the oil, etc.

To overcome these difficulties,

* "Limiters Prevent Cable Faults from Spreading on Networks," by C. P. Xenis and E. Williams, "Electrical World," October 7, 1939.

therefore, the three-layer insulating pad was developed. The outer layer, $\frac{3}{64}$ in. thick, is fully cured rubber and contains anti-oxidants and necessary accelerators to impart to it all the desirable physical characteristics of good mechanical strength, aging qualities, resistance to oil and water and dielectric strength. Since this layer forms the outside surface of the joint when the pad is used as insulation, it is this layer which bears the brunt of the damaging effect of air, oil and water.

Middle Layer

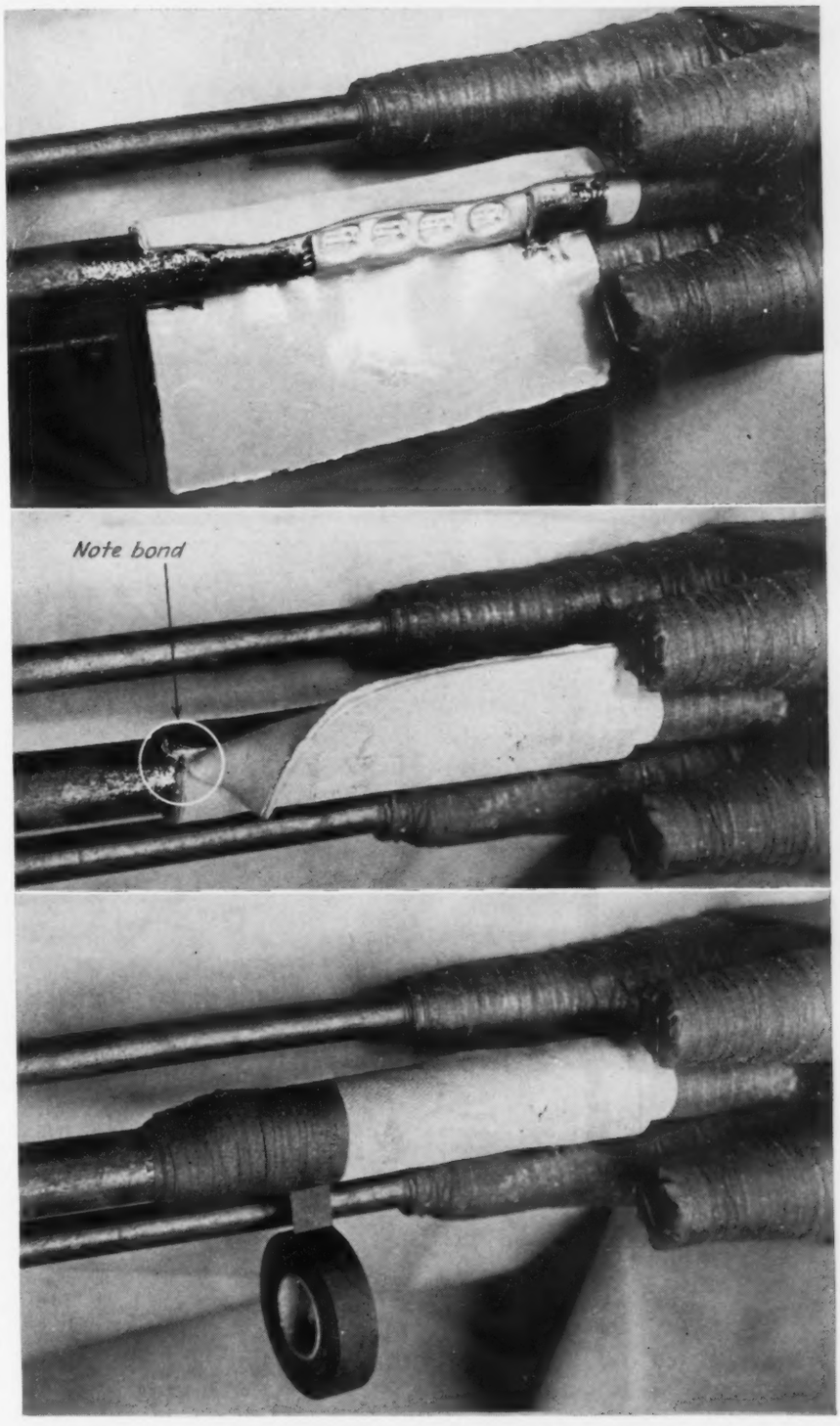
The middle layer is also $\frac{3}{64}$ in. thick and of the same composition as the outside layer, except that it is only partially cured and therefore softer and more flexible. Since this middle layer is provided with accelerators, it is subject to very slow curing as the result of heat from the cable. In other words, as the result of heat from the operating load of the cable, this layer will slowly cure over a period of years, thus approaching the physical and electrical properties of the outer layer described.

The inner layer of the pad is $\frac{3}{32}$ in. thick and is entirely uncured and therefore quite soft and very adhesive. It contains anti-oxidants but no accelerators. It is this layer that forms a permanent bond to the cable rubber over which the pad is applied, since a definite fusion takes place when this material comes in contact with other rubber surfaces. It also flows readily under slight pressure, and when the pad is wrapped in place this layer of soft uncured rubber flows and fills all voids and interstices, forming a complete sheath of insulation around the joint. Hence this layer serves both as an adhesive and as a filler. A small degree of cure in this layer will result only from the migration of accelerating agents from the other layers of the pad.

Protective Coverings

A protective layer of Holland cloth covers the uncured surface and a layer of rubberized cloth the vulcanized surface. These cloths protect the surfaces from mechanical damage and insure a clean surface, necessary for proper adhesion when the pad is applied. A label attached to the outer surface of the Holland cloth desig-

[*Continued on page 157*]



STEP-BY-STEP procedure for applying a pad to a straight joint between a 500,000-circ.mil rubber-insulated, braid-covered cable and the stub of a crab joint

1. Remove the necessary insulation from cable for making the electrical connections. 2. Remove braid and tapes from rubber insulation for sufficient length (approx. 1½ in.) to expose rubber for covering with pad. 3. Clean exposed rubber cable insulation and one inch of braid with abrasive cloth. 4. Make the electrical connections. 5. Apply thin layer of automotive rubber bonding cement to cleaned insulation and braid. 6. Remove Holland cloth and rubberized cloth from pad. 7. Wrap pad half way around joint, centering pad so that it covers adequately both sides (top). 8. Apply a thin layer of suitable cement to portion of vulcanized surface of pad which will be covered by overlap. 9. Wrap pad tightly around cable, making necessary overlap and pressing the pad firmly in place (middle). 10. Cover pad with two half-lapped layers of friction tape applied with considerable tension, extending taping approximately one inch over cable braid (bottom). 11. Paint entire joint with suitable oil-resistant paint. Other installations, such as rubber-insulated, lead-sheathed cables and other types of crab joints are handled in a similar manner with small variations in procedure.

Pattern of Station Auxiliary Drives Is Changing

Squirrel-cage motors largely the accepted drive — Adjustable-speed motors and couplings have favor for fan and feed-pump drives — Continued trend from auxiliary generators to transformer supply noted

J. C. CUNNINGHAM, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.*

IN THE MIDST of the electric utility industry's present large-scale building program an interesting comparison may be drawn between the essential auxiliary practice of the last few years and that of the years preceding 1930. Although the intervening period was one of low activity in steam power station construction, many changes have occurred in auxiliary equipment and practice.

For the purpose of this comparison a survey has been made of recent construction and data on the essential auxiliary drives and power supply will be compared with similar data published in 1930 by the N.E.L.A.[1] Fourteen complete expansion and eleven superposed installations ranging from 5,000 to 165,000 kw. capacity have been selected for study. These 25 installations are now on order or have been put into operation since 1935. In order to compare station designs or "schools of thought" the tables are based on number of installations rather than total horsepower or number of motors. For example, all of the boiler feed pump drives in a new station or extension are represented as one unit in the table.

Table I shows the division of practice between steam and electric drive.

Table I—Steam vs. Electric Auxiliary Drive

Driven Auxiliary	No. of Installations	Steam Turbine	Electric Motor	Comb. Steam and Electric
B.F. pump	25	5	7	13
Cond. pump	14		12	2
Circ. pump	14		13	1
F.D. fan	25		25	
I.D. fan	25	2	23	
Primary air Fan (separate)	11		11	
Pulverizer	20		20	
Stoker	5		5	
Total	184	7	161	16

*Central-station engineer.

[1] "Electrically Driven Auxiliaries for Steam Generating Stations" report of the Electrical Apparatus Committee, Engineering National Section; National Electric Light Association, Pub. No. 088.

It is interesting to note that the five boiler feed-pump and two induced-draft fan installations which are exclusively turbine driven are all associated with superposed turbines where exhaust steam is needed for feedwater heating. The one turbine drive on circulating pumps is a standby and the two condensate pumps are in tandem with boiler feed pumps. One may conclude that turbines are used primarily for heat balance and as standby on boiler feed pumps.

In Table II the electrically driven auxiliaries of these same stations are listed separately. The type of motor used for each essential auxiliary and the output controlling element of the fans and adjustable-speed pumps are shown.

Table II—Electrical Auxiliary Drives

Motor	Squirrel-Cage					Wound Rotor	Direct Current
Controlling Element	Damper	Inlet Vane	Hydraulic Coupling	Electric Coupling	Other	Secondary Resistance	Field and Armature Resistance
B.F. pump			1		16	3	
B.F. booster pump			1				
Cond. pump			1		10	3	2
Circ. pump					12		2
F.D. fan	3	12	7	1		1	2
I.D. fan	2	9	8	1			
Pri. air fan (separate)	10				20		
Pulverizer					3		
Stoker							

Boiler Feed Pumps

In contrast to the decided predominance of squirrel-cage motors indicated above for boiler feed pumps, the 1930 N.E.L.A. survey[1] of 37 new units showed eighteen squirrel-cage, sixteen wound rotor and one d.c. motor. The reason for this change in practice may be traced at least partially to the general increase in steam pressures which has taken place since 1930. This increase requires large, high-pressure boiler feed pumps, which may be built most economically at 3,600 r.p.m. About two-thirds of the units covered by Table I use 3,600-r.p.m. pumps. The incremental cost of wound-rotor motors, particularly at 3,600 r.p.m., is less frequently justifiable at higher pressures because

the saving in power which may be obtained by the use of adjustable speed does not increase in proportion to the pressure, motor rating and cost. One way of meeting this new condition is to use two pumps or groups of pumps in series, one step in pressure to be obtained with an 1,800-r.p.m. variable-speed pump and the other with an 1,800- or 3,600-r.p.m. constant-speed pump.

Three new developments in the adjustable-speed drive field have taken place since 1930. Both hydraulic and electric adjustable speed couplings have been used for boiler feed pumps, and a new liquid rheostat control is now available for wound-rotor motors. These will be discussed in more detail under draft fans.

Condensate and Circulating Pumps

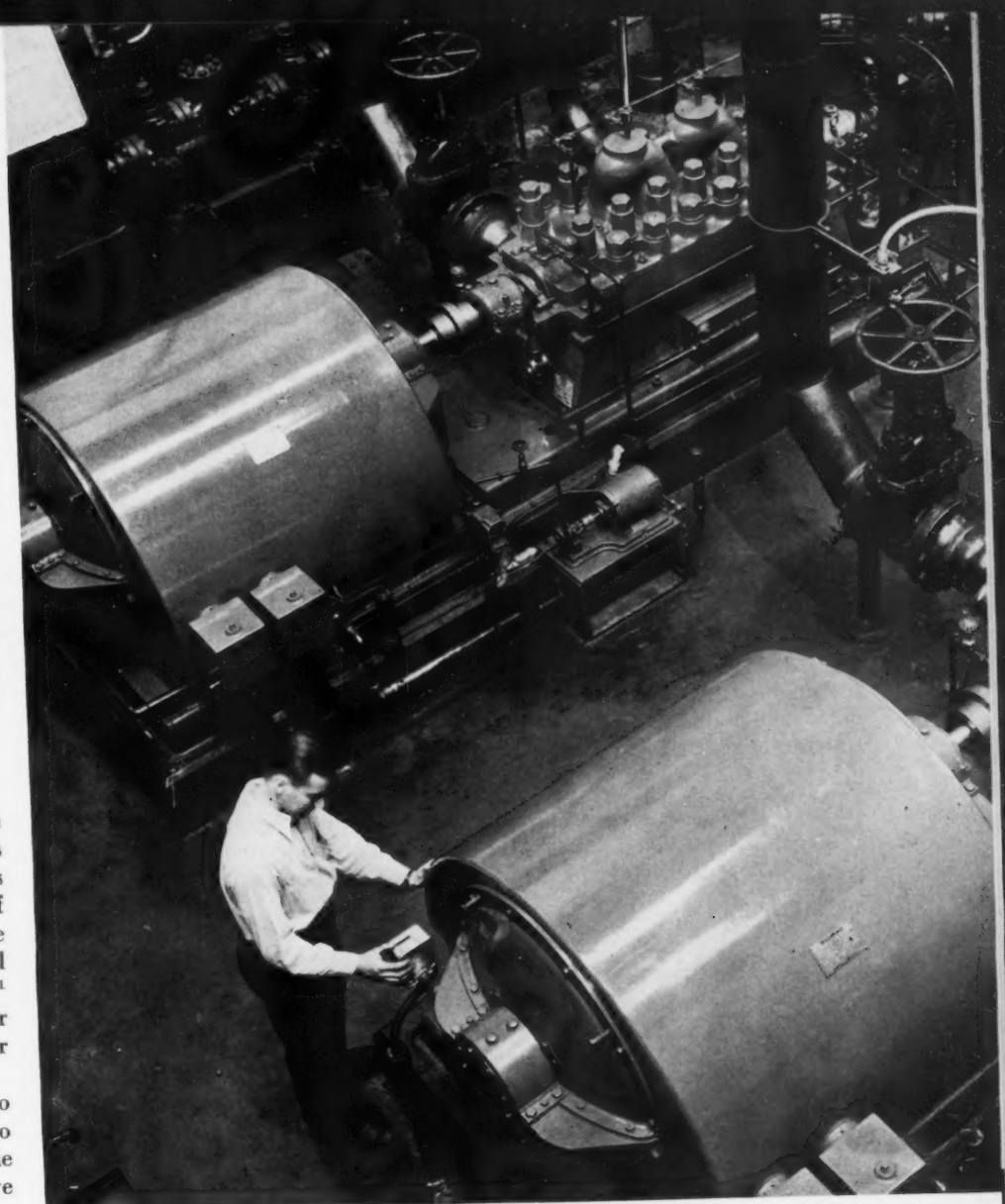
The predominance of squirrel-cage motor drives for condensate pumps is even more pronounced than is indicated by the table, since two of the three wound-rotor drives are coupled in tandem with boiler feed pumps. In the 1930 N.E.L.A. survey[1] 27 squirrel-cage, eight wound-rotor and one d.c. motor were recorded for condensate pumps.

Circulating pump drives are also mainly squirrel-cage motors. The two d.c. drives were engineered by the same company and the turbine drive is a standby. All of the squirrel-cage motors in the table are single-speed, whereas in the 1930 summary there were seven multi-speed squirrel-cage motors and three of five wound-rotor motors were arranged for speed control.

Draft Fan Drives

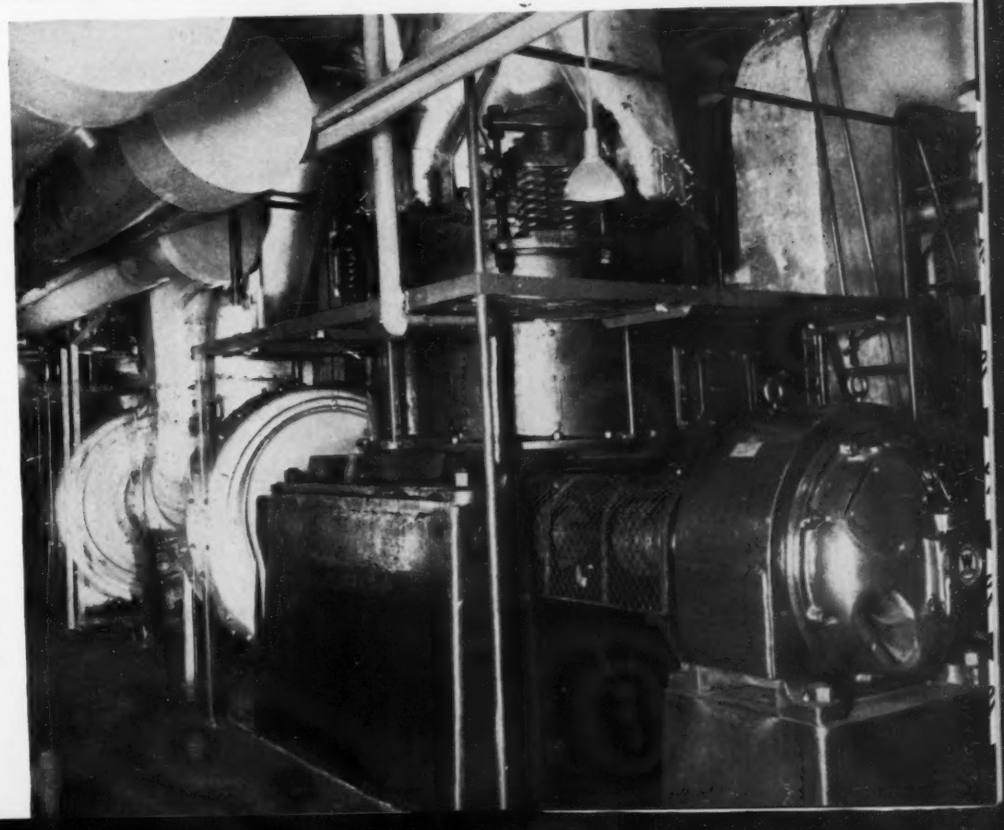
There is a greater diversity of practice in draft fan drives than for any of the other auxiliaries. Squirrel-cage motors predominate, but the case for adjustable speed is so strong (due to power savings and reduced maintenance) that adjustable-speed couplings, wound-rotor motors, or d.c. motors are used about as often as the constant-speed drives. In addition a great many of the inlet-vane and damper-controlled fans use two-speed squirrel-cage motors or two motors in tandem in order to obtain reduced speed for medium and light loads.

In the 1930 summary[1] fifteen wound-rotor motor installations were recorded on forced-draft fans and fourteen on induced-draft fans (out



HIGH-PRESSURE PUMPS driven by 1,000-hp., 3,600-r.p.m. motors

SQUIRREL-CAGE MOTOR coupled to pulverizer and exhauster *Courtesy Combustion Engineering Company*



of 37 stations). At that time vane-controlled fans were rather new[2] and adjustable-speed hydraulic couplings had not yet been introduced for this service.[3] Either of these devices provided continuously adjustable control of fan volume without intermediate dampering, and with economy comparable to a conventional wound-rotor motor installation. As a result a general shift of practice occurred which may be readily seen from Table II.

In 1937 a new type of liquid-rheostat control was developed for wound-rotor motors in dredge pump service that gives continuous speed control without the numerous ills of previous liquid rheostats. The design is such that high current densities are eliminated and a forced-circulation electrolyte cooling system maintains uniformly low temperatures. A water-cooled heat exchanger is employed to dissipate the secondary losses. This device has been so successful that it is now being proposed for draft-fan service. The elimination of finite steps with intermediate dampering results in an over-all efficiency higher than a squirrel-cage motor and hydraulic coupling, and on some load cycles the average power input is less than for a squirrel-cage motor and inlet-vane controlled fan. This new control may bring about a return to wound-rotor motor drives.

Table III—Auxiliary Power Supply

Normal Supply

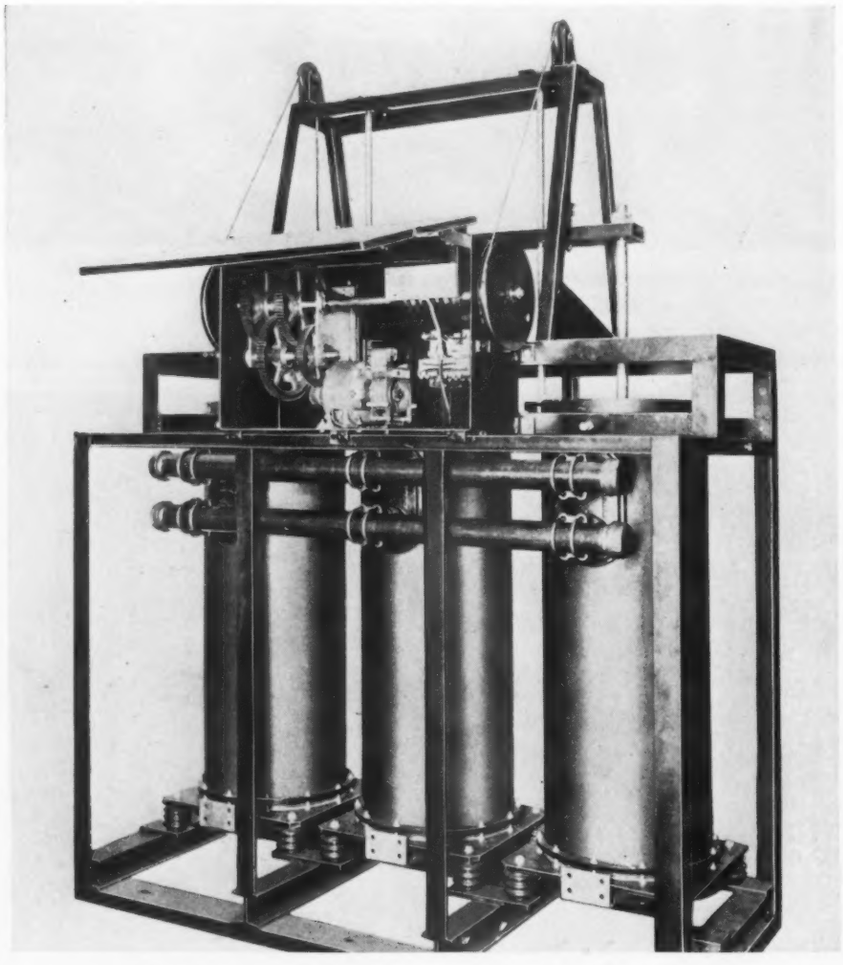
Source	Number of Installations 1935–1940	1924–30[1]
Transformers from the station bus..	15.5	16
Transformers from the generator leads.....	3.5	7
House turbine-generators.....	2 (D.C.)	6 (A.C.) 1 (D.C.)
Shaft generators...	0	10
Total.....	21	40

Standby Supply

Transformers from the station bus..	10	20
Transformers fed from outside lines	3	6
House turbine-generators.....	2 (A.C.)	7
Total.....	15	35

[2] The first central-station installation was in 1927, at the Weymouth station of the Boston Edison Company.

[3] The first central-station installation was at the municipal plant of the city of Colorado Springs, Colo., in 1931.



LIQUID RHEOSTAT for speed control of auxiliaries by secondary control of large wound-rotor motors

Electric Coupling

Another new development in draft fan drives is the adjustable-speed electric coupling. It is used with a constant-speed motor in a manner generally similar to the hydraulic-coupling drive. Water cooling and the use of oil are eliminated, but the mechanical design is somewhat complicated and d.c. excitation must be provided. The efficiency of the electric coupling will generally be slightly lower than the hydraulic coupling due to higher windage losses and excitation. Excitation can be furnished by a direct-coupled exciter, a motor-generator or from the d.c. bus. Since excitation must be provided for the coupling, synchronous motors entail less additional complication than would otherwise be involved, and their use is being seriously considered. Electric coupling installations have now been made on both draft fans and boiler feed pumps, and as operating experience accumulates the position of this drive in the field will become more apparent.

Primary air fans and pulverizers are nearly always driven by squirrel-cage induction motors. The flow of primary air and coal is regulated by dampers in conjunction with any of several means of coal feed control.

Table II shows an approximately equal division of practice between d.c. motor drives and squirrel-cage motors (with mechanical speed or stroke control) for stoker service. In the 1930 N.E.L.A. summary only two of twelve stoker installations were squirrel-cage motor driven, while six were d.c., three were brush-shifting a.c. and one was driven by a wound-rotor motor.

Auxiliary Power Supply

Auxiliary power supply practice has also changed in the last ten years. Table III summarizes the available information regarding the normal

[*Continued on page 153*]

Annual Report of Utility Load Building in 1940

Utility and dealer sales of lighting devices and appliances reach higher levels — Increase of 9.1 per cent achieved with 17 per cent less money — Highest usage in history

By HENRY G. DOOLEY, Associate Editor

SALES EXECUTIVES of the important utility companies in the United States raised their residential load building and revenue building to new and higher levels during the year 1940. First impact of defense business on utilities was a 16.5 per cent increase in kilowatt-hour sales to industries at a price requiring a program of compensating load building in other classifications of service. To meet this challenge utility sales executives speeded ahead with balanced load building by connecting almost a million new residential customers to the lines and by selling to the homes of America the largest number of kilowatt-hours in the history of the industry.

Scope of Survey

As shown below on this page, despite rate cuts and the dilution of new customers, utilities broke the records they set last year by increasing their own volume of sales by 4.6 per cent, and dealer sales 14 per cent, by increasing utility-and-dealer sales per customer by 9.1 per cent, by increasing usage 7 per cent and the average bill 1.2 per cent. Furthermore, while these new sales records were being established, utilities were decreasing utility expenses per customer 17 per cent.

Trend of sales is reflected also in the "Cross-Section of Residential Load Building for 1940," charted on a following page. Combined utility and dealer sales amount to $37.80 per residential customer, compared to $38.10 a year ago. But in the past year 885,465 new residential customers were added to the lines.

An innovation this year is a second "cross-section chart" constructed from data supplied by the companies comprising Table IV. These companies place all their sales through their local co-operating dealers. These companies secured a larger sales volume per customer than did the rest of the industry and secured almost the same increase in average usage.

Due to the co-operation of utility sales executives, this survey embraces practically every type of utility sales and promotion program in the nation at this time. Four pages of the survey are given over to data reported by utility companies and are published so that sales executives may analyze their own operations.

Numerous companies comment each year that the comparative figures shown here do not conform with those reported in the annual statistical issue published each January by ELECTRICAL WORLD. The same situa-

UTILITY SALES AND LOAD-BUILDING PROGRAMS DURING 1940

As reported by 114 utility companies serving 12,334,234 residential consumers and listed in Table I, on following pages:

1	Utilities' dollar sales volume increased	4.6%
2	Dealers' dollar sales volume in same territory increased	14%
3	Dollar sales volume per customer, by utilities and dealers combined, increased	9.1%
4	Average usage went up	7.0%
5	Average annual bill went up	1.2%
6	Utilities' sales and promotional expenses per customer dropped	17%

Residential Lighting and Appliance Sales and Promotion

Table I— Total sales of household appliances by 113 power companies during the full year 1940, together with estimates of dealer sales of refrigerators, ranges and water heaters in the same areas.

Company	Domestic Consumers Dec. 31	Average Annual Domestic Kw.-Hr. Consumption		Av. Rev. per Consumer	Av. Price, Cents per Kw.-Hr.	Refrigerators					Ranges					Water Heaters				
						Units Sold By Power Companies		Units Sold By Dealers Pwr. Co. Est.		Saturation %	Units Sold By Power Companies		Units Sold By Dealers Pwr. Co. Est.		Saturation %	Units Sold By Power Companies		Units Sold By Dealers Pwr. Co. Est.		Saturation %
	1940	1940	1939	1940	1940	1940	1939	1940	1939	1940	1940	1939	1940	1939	1940	1940	1939	1940	1939	1940
I—NORTHEAST—North of the Ohio River, East of the Mississippi River																				
1	624,349	1,094	1,025	36.73	3.36	3,599	2,423	.....	.....	60.	8,390	6,437	9,063	5,880	16.	1,334	1,190	194	102	0.7
2	[G] 595,369	1,091	1,025	38.32	3.51	10,294	7,147	63,400	52,800	68.	1,746	2,019	2,300	2,582	8.	1,150	1,598	989	997	4.0
3	[GQ] 356,054	784	741	40.18	[Q] 5.12	3,642	2,400	26,056	19,759	58.	1,591	1,312	4,160	3,611	10.	247	296	332	456	2.0
4	342,286	773	743	38.89	5.03	3,141	2,615	.....	.....	.....	772	918	987	656	5.1	93	132	50	33	0.3
5	242,814	1,222	1,161	35.14	2.88	.....	.....	16,342	15,115	48.8	1,590	1,749	5,436	3,998	20.9	835	716	236	195	3.8
6	[G] 237,907	928	874	42.88	4.62	978	407	10,492	8,587	.....	945	283	908	745	.....	884	238	308	271	.....
7	236,604	964	894	35.40	3.67	.....	.....	16,414	11,441	54.	3,344	2,688	2,674	2,234	16.	922	873	676	492	4.0
8	221,750	1,149	1,060	33.34	2.90	1,220	825	15,780	11,175	46.	785	737	2,690	2,343	10.	155	158	1,335	1,017	3.0
9	[G] 153,271	1,107	1,047	44.47	4.01	5,046	2,876	5,800	3,500	71.	1,587	1,354	525	475	12.	648	733	200	220	4.0
10	[G] 123,123	812	767	36.49	4.49	1,815	1,159	14,630	10,562	60.	149	164	525	401	.....	66	88	180	186	.....
11	[G] 119,305	887	842	44.05	4.97	2,210	1,283	.....	.....	.....	163	125	.....	.....	.....	20	14	.....	.....	.....
12	118,151	781	726	31.39	4.02	1,105	855	.....	.....	.....	851	593	716	364	4.1	100	97	17	30	0.3
13	[G] 107,871	886	820	41.12	4.65	553	407	6,875	5,800	54.6	477	311	1,750	1,800	12.5	167	140	500	600	4.1
14	106,219	1,011	916	37.21	3.68	2,469	1,321	10,000	7,347	.....	664	721	2,154	1,571	.....	89	26	179	30	.....
15	[G] 97,205	921	862	44.14	4.79	1,521	980	6,400	4,138	40.3	724	692	779	444	13.6	331	325	362	191	6.1
16	[G] 96,915	889	834	37.37	4.20	.....	.....	11,147	7,544	71.	403	292	489	305	5.8	163	116	102	57	1.0
17	[G] 92,903	861	809	48.27	5.61	3,215	2,916	4,000	3,800	79.5	1,067	856	196	175	8.7	526	446	40	25	2.9
18	85,889	602	842	42.26	4.69	.....	.....	2,182	2,083	29.	1,600	1,416	1,39	1,095	24.	410	408	483	367	4.0
19	77,776	788	746	36.67	4.65	1,925	1,334	3,086	2,366	36.6	970	868	359	360	14.4	384	361	58	56	4.1
20	73,733	727	694	28.89	3.97	.....	.....	3,431	3,527	38.	433	380	728	560	10.	23	26	4	7	0.5
21	69,530	1,059	955	38.19	3.61	.....	.....	6,401	4,444	43.	926	705	2,146	1,287	23.	213	195	435	301	5.0
22	65,521	1,153	1,084	36.91	3.20	1,698	887	3,187	1,910	53.	721	730	416	52	10.	216	201	66	7	3.0
23	63,631	801	754	39.03	4.86	1,290	991	2,359	2,007	42.4	768	683	491	408	13.9	194	193	58	63	22.0
24	55,400	810	770	37.40	5.3	1,183	906	2,900	.....	35.	587	459	125	100	13.	42	21	.....	.....	0.3
25	[G] 51,572	712	654	33.91	4.76	792	454	.....	.....	55.	767	497	.....	.....	11.2	176	113	.....	.....	1.8
26	47,790	920	867	38.36	4.17	.....	.....	4,428	3,242	62.7	.....	.....	1,289	1,075	14.4	.....	.....	.....	.....	.....
27	47,663	786	745	36.40	4.63	918	588	2,339	1,664	41.	575	552	92	146	13.	135	154	17	19	2.5
28	[G] 47,662	945	903	43.10	4.55	482	299	2,000	1,500	50.	222	253	300	400	19.	127	145	100	50	4.0
29	46,239	1,062	970	37.19	3.50	1,525	982	2,185	1,320	.....	554	495	384	256	.....	143	139	56	28	.....
30	[G] 45,943	560	537	32.38	5.78	1,201	685	1,544	1,184	47.5	68	81	56	43	3.1	4	15	.....	.....	0.2
31	44,484	1,092	991	39.32	3.60	.....	.....	4,868	3,115	62.	833	810	1,008	376	24.	319	289	348	211	7.0
32	41,937	857	809	[F] 37.72	4.40	753	587	2,454	2,073	80.	327	155	148	134	11.	74	57	8	5	0.7
33	[G] 38,542	862	796	33.68	3.91	310	203	.....	.....	67.	117	117	.....	.....	9.	15	19	.....	.....	1.0
34	37,331	877	838	37.77	4.31	445	290	1,512	1,982	51.	354	384	285	391	19.	162	180	47	65	4.0
35	[G] 36,820	778	728	41.88	5.38	806	460	.....	.....	.....	114	77	.....	.....	.....	42	46	.....	.....	.....
36	[G] 36,466	855	806	32.31	3.78	803	389	1,954	1,163	48.	327	308	83	142	7.6	123	89	12	14	1.6
37	[G] 36,393	1,048	977	45.70	4.36	976	642	2,700	2,500	70.	142	76	160	100	6.3	71	64	40	40	0.6
38	[G] 34,160	496	417	49.90	.....	323	279	.....	500	.....	84	80	.....	81	.....	3	2	.....	1	.....
39	30,207	800	768	43.45	5.44	407	353	1,378	965	51.	163	176	256	178	13.	50	51	52	23	2.0
40	27,000	969	885	[F] 33.00	.....	345	294	2,000	1,800	65.	397	316	503	289	15.	65	70	43	18	1.0
41	[G] 26,177	831	781	37.14	4.47	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
42	17,835	738	709	37.06	5.00	428	344	575	834	37.	195	172	93	90	11.6	42	43	6	14	3.3
43	[G] 14,151	809	754	39.07	4.83	180	112	764	550	27.7	165	176	243	200	16.7	70	71	45	42	3.9
44	[G] 12,109	566	531	34.50	6.09	696	456	350	390	40.	17	5	.....	.....	1.	4	3	.....	.....	.....
45	[G] 8,760	705	646	[F] 31.84	4.50	61	25	577	450	35.	.....	2	30	36	2.	.....	.....	.....	.....	.....
46	7,880	784	703	37.30	4.80	289	222	400	325	53.	169	130	75	60	15.	7	9	.....	.....	.....
47	846,442	923	889	34.99	3.79	6,995	4,675	.....	.....	.....	1,696	1,087	.....	.....	.....	701	421	.....	.....	.....
48	[G] 817,342	755	717	36.88	4.88	17,993	4,647	.....	.....	.....	235	201	.....	.....	.....	33	35	.....	.....	.....
49	[G] 405,671	1,238	1,149	36.35	2.94	8,883	5,341	.....	13,353	56.5	3,630	3,288	7,892	7,502	23.6	1,044	1,051	1,144	929	3.8
50	256,942	876	838	33.44	3.82	2,270	1,464	.....	.....	.....	285	242	.....	.....	.....	137	105	.....	.....	.....
51	184,332	1,274	1,168	38.72	3.04	4,301	2,474	10,000	4,500	59.53	2,001	1,704	2,227	2,120	*19.3	531	441	319	301	3.8
52	114,964	1,055	957	37.61	3.56	1,337	670	.....	.....	.....	1,037	1,082	837	670	.....	424	318	189	173	.....
53	25,736	834	794	37.63	4.51	850	646	.....	.....	40.	377	350	.....	.....	15.	122	173	.....	.....	8.0
Total or Average	7,752,126	[Y] 889	[Y] 832	[Y] 37.99	[Y] 4.34	101,273	59,313	272,910	221,315	[Y] 52.2	46,104	39,308	56,976	45,735	[Y] 13.5	13,836	12,694	9,230	7,636	[Y] 3.2
II—SOUTHEAST—South of Ohio River, East of Mississippi River																				
60	191,825	1,526	1,446	41.78	2.74	8,234	3,497	16,100	11,885	68.	5,024	3,154	1,969	1,531	24.5	3,094	2,264	817	613	11.8
61	166,723	910	887	34.80	3.82	.....	.....	11,534	6,500	54.	2,017	1,655	2,044	1,594	13.	371	330	318	242	2.0
62	142,246	1,202.2	1,165	42.97	3.57	.....	.....	13,123	10,305	76.5	584	767	1,745	1,023	15.6	192	177	142	81	4.3
63	124,759	1,313	1,285	38.51	2.93	1,122	826	.....	10,678	.....	1,919	1,229	.....	1,804	.....	981	665	.....	606	.....
64	124,493	1,381	1,216	52.59	3.81	465	392	19,327	14,099	64.3	760	1,197	6,907	5,045	24.7	387	489	2,865	2,041	14.3
65	97,132	1,350	1,279	40.61	3.01	154	246	13,827	11,111	80.7	391	654	4,361	3,434	25.8	292	418	1,396	1,160	7.9
66	96,780	689	643	32.07	4.65	1,062	656	8,531	5,828	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
67	[G] 95,837	758	721	36.04	4.75	2,440	1,765	7,560	5,300	60.	286	247	70	60	2.0	32	15	.....	.....	.....
68	89,900	776	734	36.48	4.5	1,219	1,059	8,157	5,178	57.	598	565	682	571	8.7	176	210	160	143	2.5
69	67,080	898	837	41.40	4.61	3,956	2,505	.....	.....	.....	1,327	997	.....	.....	.....	304	287	.....	.....	.....
70	47,260	852	808	[F] 32.52	4.05	16	115	5,461	4,405	.....	124	109	407	511	.....	53	29	172	141	.....
71	38,331	840.3	777.9	42.45	5.05	1,227	927	1,632	941	46.	1,186	973	299	161	18.	523	401	46	39	7.0
72	31,666	1,196	1,082	51.12	4.26	114	100	3,075	2,144	60.5	290	350	1,141	604	24.5	429	428	1,035	568	25.5
73	30,865	960	954	36.35	3.78	898	952	.....	.....	51.2	310	276	66	44	10.8	119	109	14	19	4.6
74	29,620	957	894	36.43	3.81	.....	.....	2,491	1,414	58.	237	232	54	74	7.	43	72	8	8	1.8

* Estimated. [A] Outside Salesmen only. [B] Inside salesmen only. [C] At net prices. [D] District representative plan.
[E] Ranges and water heaters only. [F] Excludes home lighting personnel. [FF] Excludes lamp bulbs. [G] Company has gas customers.
[I] Combined with gas expenses. [J] Includes dealers' sales. [K] Plus local managers. [L] Advertising budget only. [M] Appliance profit covers expenses.

by Utilities and their Local Dealers for the Full Year 1940

Also, comparisons of these sales totals with the year 1939, with data on average consumption, rates, revenues, saturations, sales totals, sales people and direct sales and promotional expense in building residential load—embracing more than twelve million consumers.

Washing Machines Units Sold By Power Cos.		Saturation Washing Machines, %	Ironing Machines Units Sold By Power Companies		Saturation Ironing Machines, %	Vacuum Cleaners Units Sold By Power Companies		Saturation Vacuum Cleaners, %	Total Sales of All Appliances By Power Cos. (Dollars)		Total Sales of All Appliances By Dealers (Dollars)		Power Co. Sales Per Consumer($)	Annual Rev. Inc. Pwr. Co. Sales (Dollars)	No. Power Co. Salesmen and Women Building Domestic Load		Consumers Per Sales Person	Power Co. Direct Sales Expense (Dollars)	Power Co. Advtg. & Promotion Expense (Dollars)	Sales & Adv. Exp. Per Consumer($)	Company
1940	1939	1940	1940	1939	1940	1940	1939	1940	1940	1939	1940	1939	1940	1940	1940	1939	1940	1940	1940	1940	
I—NORTHEAST—North of the Ohio River, East of the Mississippi River																					
			241	302					[C] 1,941,406	[C] 1,617,943			3 12		78	78	8,000		542,226		1
2,341	2,010		310	378		1,848	1,001		2,956,051	2,744,742	*25,000,000		5 03	321,120	[F] 277	[F] 276	[F] 2,149				2
2,132	2,178	91 0	1,038	300	2 0	3,770	2,457	66 0	[FF] 1,240,159	[FF] 1,036,024	[FF] 12,121,717	[FF] 10,700,809	[FF] 3 48	[FF] 140,370	355	356	1,000	470,644	294,825	2 15	3
1,698	1,713		220	208		1,598	1,530		*1,036,000	1,037,598			3 03		[A] 50	51					4
		80 0			6 6				264,602	290,953	3,650,000	3,500,000	1 09	138,655	74	88	3,281				5
									339,496	140,723			1 42	91,682	40		5,948				6
									[E] 468,959	[E] 402,558			[E] 1 98	[E] 157,264	73	73	3,241		[L] 84,172		7
513	616					1,402	1,319		709,774	704,913			3 20		75	75	2,956				8
1,022	995	80 0	432	288	6 0	940	993	80 0	1,312,949	1,007,550			8 56		136	128	1,127	151,694	72,901	1 47	9
240	216		23	39			31		362,746	291,885			2 94		60	60	2,052	85,274	133,248	1 77	10
438	344		147	97		136	106		433,839	319,160			3 62		26	26	4,590				11
									296,000	251,000			2 50	[J] 242,000	40	36	2,954				12
83	97		10	21					213,710	165,519			1 98	35,000	14	14	7,705	45,875	42,275	0 82	13
268	249		173	108		174	173		720,442	598,545			6 80		110	109	966				14
441	540		133	112		*800			509,472	474,828	3,560,000	2,900,000	5 24	54,934	88	56	1,104	118,489	39,375	1 62	15
									[E] 52,395	[E] 42,185	3,190,000	2,574,506	[E] 0 54	[E] 29,070	25	26	3,879	22,555	53,194	0 78	16
829	858	55 0	315	257	4 4	848	981	75 0	946,520	912,520			10 20	207,270	50	50	1,858	(I)	(I)		17
									[E] 175,360	[E] 162,132	[T] 102,378	[T] 102,009	[E] 2 04	[E] 74,000	27	27	3,180		[L] 38,099		18
1,333	1,152		229	166		523	438		737,449	696,936			9 48		42	28	1,851	53,136	20,537	0 95	19
									[E] 64,413	[E] 62,559			[E] 0 87	[E] 16,508	17	17	4,337		[L] 21,274		20
									[E] 137,296	[E] 119,320			[E] 1 97	[E] 41,856	20	20	3,476		[L] 23,391		21
869	772		119	101		570	462		574,977	475,717			8 76		[N] 28	31	2,340				22
1,071	931		245	205					475,482	465,107			7 48		32	37	1,988	236,733	80,533	4 98	23
			48	40					205,000	185,000			3 71	48,000	[D] 12	12	4,616				24
139	132	60 0	35	48	3 0	157	188	65 0	320,132	235,521			6 20	[J] 104,653	33	25	1,562	60,127	40,000	1 94	25
																					26
834	661		150	194		350			443,075	407,816	1,723,000	1,665,000	9 30		35	37	1,361	97,246	36,314	2 80	27
55	48		10	5		63	122		131,000	116,000		700,000	2 74	18,500	10	10	4,766	22,900	2,600	0 53	28
499	591		197	245		215	328		414,817	384,022			8 95		[N] 32	32	1,445				29
412	184	65 0	55	61	3 0	275	100	60 0	[D] 316,000	[D] 240,000			[D] 6 89	47,000	[D] 69	[D] 75	[D] 665	(D)	(D)	(D)	30
									[E] 133,362	[E] 125,298			[E] 3 01	[E] 42,748	19	19	2,340		[L] 33,703		31
106	105	65 0	22	18	10 0	188	120	10 0	219,511	191,809	927,295	717,315	5 25	35,344	18	18	2,330	76,843	16,679	2 24	32
									108,159	113,467			2 82								33
						210	147		204,502	219,354			5 48	34,985	20	20	1,866	21,750	116,376	3 70	34
261	254		83	72		302	167		203,623	159,378			5 62	35,277	30	30	1,227	96,291	56,343	4 13	35
286	257		71	54		212	200		231,051	188,710			6 24		[N] 25	30	1,460				36
982	764	75 0	87	76	7 5	864	606	55 0	420,210	365,698	1,100,000	940,000	11 58	56,061	26	26	1,400				37
201	319		6	12		217	435		135,931	155,171			3 98	22,519	10	10	3,416	26,750	11,240	1 11	38
52	55		1	3					131,384	112,140			4 35	[J] 76,182	10	10	3,021	8,986	4,000	0 43	39
75	70		10	10					129,000	123,000			4 78	[J] 40,000	7	7	3,857				40
151	120		75	37		95	114		70,496	68,238			2 70		17	17	1,539				41
415	280		46	32					167,465	156,984			9 39		10	10	1,784	66,157	15,017	4 55	42
76	76		33	16	4 0	14			78,646	78,184			5 56	11,253	5	6	2,830	13,138	8,750	1 55	43
296	228	75 0	37	33	15 0	212	151	90 0	152,241	124,582	95,000	93,437	12 58	60,000	9	9	1,345	41,161	7,262	3 98	44
17	29	90 0	8	6	6 0	13	40	70 0	23,492	19,515	201,519	198,872	2 68	5,134	10	10	876	15,441	9,005	2 79	45
162	131		15	22		114	58		91,080	79,634			11 58		5	5	1,576	6,868	3,412	1 30	46
3,167	3,199		871	704		6,505	5,426		4,600,592	3,903,256			5 44		655	603	1,292				47
6,349	7,270		1,863	1,631		4,709	5,460		4,302,066	2,702,454			5 26		236	291	3,460				48
2,392	2,266		968	867		3,113	2,325		2,380,682	1,983,970			5 88		250	250					49
2,043	1,793		117	124		2,985	2,288		1,258,932	1,048,565			4 88	134,000	197	244	1,305				50
1,524	1,417		704	752		770	771		1,345,648	1,167,490			7 29		[N] 173	203	1,068				51
252	169		27	35		670	502		614,290	507,046			5 35	97,784	58	58	1,978				52
406	379	50 0	35	44	4 0	156	93	68	294,634	273,982			11 50		20	20	1,286				53
34,430	33,468	[Y] 72 0	9,269	7,723	[Y] 11 7	35,018	29,132	[Y] 64 0	35,096,518	29,516,701	51,670,909	24,091,948	[Y] 5 46	2,419,169	3,738	3,749	2,469	1,738,058	1,806,741	[Y] 2 19	Total or Av.
II—SOUTHEAST—South of Ohio River, East of Mississippi River																					
1,421	1,027		139	139		847	562		2,806,202	1,991,502			14 62		[N] 150	120	1,278				60
									[E] 275,423	[E] 226,730			[E] 1 66	[E] 87,452	42	42	3,969		[L] 41,133		61
126	130		8	11		592	392							[T] 28,000	[B] 7	10					62
772	729		70	89		297	238		763,732	620,724			6 12		30	27	4,158				63
161	163		16	23		273	294		308,868	364,379	8,530,217	6,500,515	2 48	60,481	58	60	2,146	156,600	205,262	2 90	64
4	10					10	9		348,780	471,406	6,978,147	4,530,106	3 58	63,826	56	49	1,734	47,321	238,606	2 94	65
394	566		35	35		189	231		351,543	373,286	3,947,015	3,393,679	3 59	100,262	68	69	1,423				66
1,057	993	67 0	158	201	3 4	530	256	65 0	922,113	778,756	2,300,000	1,947,000	9 64	107,524	128	98	748	143,902	97,277	2 54	67
720	691		45	79		614	333		508,203	475,816	2,747,807	2,272,091	5 66	41,309	39	51	2,304				68
974	1,041		90	122		160	147		1,204,490	1,037,716			18 00		54	54	1,242				69
47	60					30	114		96,893	133,468	2,152,510	2,394,137	2 04	31,071	40	40	1,181		271,624	5 74	70
41	52		2	7		32	60		395,696	335,118			10 40	110,744	20	20	1,916	99,993	80,289	4 70	71
13	6	24 0	3		0 5			15 0	145,954	167,872	1,447,346	1,015,000	4 60	65,000	12	12	2,555	58,184	83,200	4 46	72
132	166		6	16		47	64		235,345	246,526			7 60		[NK] 10	12	3,086				73
									[E] 42,310	[E] 44,843			[E] 1 43	[E] 10,252	9	9	3,291		[L] 7,465		74

[N] Does not include home economists or home lighting personnel.
[E] In territory beyond company gas mains.
[B] Adjusted.
[P] Decrease due to rate reduction.
[T] Major appliances only.
[TT] Lamp bulbs and major appliances only.
[Q] Includes rural.
[QQ] Includes irrigation and spray.
[Y] Straight line average.
[Z] Weighted average.

Residential Lighting and Appliance Sales and Promotion

Table I— Total sales of household appliances by 113 power companies during the full year 1940, together with estimates of dealer sales of refrigerators, ranges and water heaters in the same areas.

Company	Domestic Consumers Dec. 31	Average Annual Domestic Kw.-Hr. Consumption		Av. Rev. per Consumer	Av. Price, Cents per Kw.-Hr.	Refrigerators					Ranges					Water Heaters				
						Units Sold By Power Companies		Units Sold By Dealers Pwr. Co. Est.		Saturation %	Units Sold By Power Companies		Units Sold By Dealers Pwr. Co. Est.		Saturation %	Units Sold By Power Companies		Units Sold By Dealers Pwr. Co. Est.		Saturation %
	1940	1940	1939	1940	1940	1940	1939	1940	1939	1940	1940	1939	1940	1939	1940	1940	1939	1940	1939	1940
II—SOUTHEAST—South of Ohio River, East of Mississippi River—(Concluded)																				
75	25,995	1,543	1,413	46.54	3.01	973	519	1,003	750	58.2	479	393	334	180	21.1	326	218	152	75	10.2
76	25,066	772	746	31.43	4.07	.....	.....	2,302	1,236	52.	258	229	144	98	9.	38	30	16	15	1.0
77	20,975	1,156	1,081	39.17	3.4	294	216	750	1,000	58.6	376	252	106	79	18.7	169	157	52	35	6.3
78	G 19,925	1,068	1,008	38.39	3.59	146	.....	.....	.....	72.	189	.....	.....	.....	10.5	48	.....	.....	.....	1.75
79	16,835	1,346	1,259	44.39	3.30	727	238	961	1,011	58.3	325	216	305	174	21.2	154	112	211	105	12.4
80	6,316	1,197	1,100	36.03	3.01	.....	.....	888	625	72.	159	143	412	190	36.	40	37	87	41	7.0
Total or Average	1,489,629	Y 1,081	Y 1,016	Y 39.62	Y 3.80	23,047	14,013	116,722	94,410	Y 61.6	16,839	13,638	21,046	17,177	Y 17.1	7,771	6,448	7,491	5,932	Y 7.5
III—CENTRAL—West of Mississippi River, East of Rocky Mountains																				
87	G 340,000	1,205	1,112	39.70	3.3	4,599	3,853	.....	.....	.....	3,038	2,743	3,802	3,477	16.	1,763	2,100	1,965	1,802	7.0
88	G 314,695	1,076	1,014	34.14	3.17	1,131	1,193	33,144	27,299	83.	1,433	1,265	3,998	3,189	9.1	.....	.....	.....	.....	.....
89	134,882	889	864	33.18	3.73	1,731	1,001	16,242	12,620	.....	19	29	54	49	.....	4	11	2	4	.....
90	114,969	1,046	1,004	40.13	3.84	1,738	1,638	.....	.....	.....	2,202	1,588	710	499	.....	336	299	38	15	.....
91	104,195	676	683	35.49	5.25	41	116	16,009	12,033	45.	453	328	525	497	4.5	32	38	54	98	1.0
92	82,487	803	794	36.49	4.54	18	16	12,817	8,910	.....	7	13	79	110	.....	1	2	10	14	.....
93	G 77,197	1,021	1,014	41.89	4.10	2,392	1,465	5,000	5,028	60.1	859	881	215	206	10.6	435	498	45	53	4.6
94	74,176	1,038	971	37.49	3.61	431	226	9,451	6,576	76.	343	308	375	351	7.9	192	164	209	113	2.4
95	70,290	767	749	35.60	4.64	42	68	10,252	6,845	.....	2	42	454	227	.....	6	20	104	39	.....
96	65,914	821	836	39.21	4.70	1,529	1,412	5,106	5,051	58.7	238	294	55	31	4.17	66	106	4	3	1.25
97	GG 65,872	830	760	37.93	4.55	1,177	823	4,400	3,200	40.	441	512	150	130	11.	351	446	80	70	4.0
98	61,025	890	880	44.75	5.04	1,814	1,322	5,442	3,604	.....	575	525	122	126	.....	189	220	35	34	.....
99	G 42,550	854	784	37.69	4.41	1,271	907	3,129	.....	.....	451	521	85	.....	.....	440	441	36	.....	.....
100	41,870	987	920	37.87	3.84	569	348	2,446	1,993	37.	406	456	555	395	18.6	211	153	154	93	4.3
101	39,180	1,002	990	46.36	4.63	2,989	1,909	1,683	1,402	.....	505	504	21	43	.....	205	318	9	8	.....
102	37,505	644	619	31.08	4.83	194	205	4,306	3,963	44.	28	21	98	240	3.9	24	23	38	75	1.0
103	32,819	643	604	33.94	5.03	1,283	962	.....	.....	.....	141	150	.....	.....	.....	69	71	.....	.....	.....
104	29,703	988	923	39.01	3.98	684	627	.....	.....	34.2	523	413	.....	.....	24.9	200	197	.....	.....	4.9
105	G 24,168	796	765	38.70	4.86	552	373	1,880	1,392	58.4	204	231	52	63	9.3	35	24	11	13	1.4
106	22,791	1,179	1,128	40.90	3.52	603	506	1,336	1,173	68.3	325	328	39	30	17.7	372	334	22	22	10.6
107	20,938	877	823	42.78	4.87	384	405	704	525	52.4	291	276	93	69	16.	70	52	22	8	1.2
108	20,412	888	844	38.80	4.3	1,282	992	500	600	70.	196	180	50	40	20.	16	21	5	3	1.0
109	G 19,482	836	787	35.88	4.29	.....	2	2,476	2,127	.....	.....	.....	9	8	.....	.....	.....	.....	.....	.....
110	17,688	668	642	36.69	.....	269	172	465	397	46.6	131	130	39	51	11.8	3	17	5	3	0.7
111	15,019	654	609	35.66	5.5	615	418	797	747	55.	228	176	89	57	16.	61	57	17	19	3.0
112	11,539	877	835	41.71	4.76	179	109	924	654	63.2	182	184	124	93	18.1	91	69	37	43	6.4
113	G 6,921	779	709	38.17	4.9	190	182	200	150	40.	8	7	15	12	.....	.....	1	4	4	.....
114	G 3,266	1,123	1,046	40.08	3.57	89	77	.....	.....	.....	141	97	.....	.....	.....	63	41	.....	.....	.....
Total or Average	1,891,553	Y 888	Y 847	Y 38.26	Y 4.36	27,796	21,327	138,709	106,289	Y 54.8	13,370	12,202	11,808	9,993	Y 12.2	5,235	5,723	2,906	2,536	Y 3.4
IV—WESTERN—Rocky Mountains to Pacific Coast																				
122	460,429	984	977	36.60	3.72	.....	.....	.....	35,893	60.	1,741	1,798	2,953	2,925	9.5	771	640	761	804	4.5
123	GG 179,760	GG 1,511	GG 1,391	GG 35.31	2.34	762	653	21,954	10,063	47.5	2,157	2,657	7,159	2,852	31.	2,192	1,956	2,739	973	14.0
124	G 115,531	759	700	34.85	4.62	2,510	1,539	.....	.....	55.	589	591	.....	.....	3.	111	109	.....	.....	0.5
125	105,925	1,193	1,116	39.98	3.35	515	773	13,404	8,671	69.0	655	1,158	3,303	2,335	40.5	270	661	540	329	6.5
126	G 82,963	994	954	32.41	3.25	603	398	10,097	7,701	.....	332	207	268	323	.....	299	229	226	251	.....
127	65,732	2,195	2,060	44.78	2.04	222	229	9,769	7,244	58.5	807	758	3,372	1,852	29.2	1,074	1,385	2,213	1,047	26.7
128	60,761	1,689	1,606	42.35	2.51	916	520	8,177	5,533	42.	961	798	1,676	1,163	22.	573	515	1,015	743	16.5
129	57,523	1,945	1,855	51.10	2.63	497	579	8,060	4,262	.....	741	1,330	3,155	2,220	55.	562	1,006	1,045	677	25.0
130	26,072	1,127	1,028	46.36	.0411	21	10	3,527	2,256	60.	23	8	151	166	10.	8	10	64	56	4.0
131	25,380	1,349	1,376	49.86	3.69	679	395	.....	.....	61.3	283	207	.....	.....	23.4	183	183	.....	.....	13.8
132	20,850	930	891	40.40	4.5	362	347	2,008	1,665	45.	390	335	170	125	22.	178	122	65	39	6.0
Total or Average	1,200,926	Y 1,334	Y 1,268	Y 41.27	Y 2.97	7,087	5,443	76,996	S 47,395	Y 55.4	8,679	9,847	22,207	13,961	Y 24.6	6,221	6,816	8,668	4,919	Y 11.8

* Estimated. A Outside Salesmen only. B Inside salesmen only. C At net prices. D District representative plan.
E Ranges and water heaters only. F Excludes home lighting personnel. FF Excludes lamp bulbs. G Company has gas customers.
I Combined with gas expenses. J Includes dealers' sales. K Plus local managers. L Advertising budget only. M Appliance profit covers expenses.

Table II—Regional Summary and Comparison of Power

Summarizes by regions power company sales and load building data shown in Table I. Local sales pace and direction determined by

Region	Total Domestic Consumers Dec. 31, 1940	Av. Dom. Kw.-Hr. Consumption 1940	Kw.-Hr. Increase Over Dec. 31, 1939	Av. Cost of Dom. Service Cents per Kw.-Hr. 1940	Av. Revenue per Consumer 1940	Refrigerators Units Sold By Power Cos. 1940	Ranges Units Sold By Power Cos. 1940	Water Heaters Units Sold By Power Cos. 1940	Washing Machines Units Sold By Power Cos. 1940	Ironing Machines Units Sold By Power Cos. 1940	Vacuum Cleaners Units Sold By Power Cos. 1940	Refrigerators Sold per 1,000 Consumers 1940	Ranges Sold per 1,000 Consumers 1940	Water Heaters Sold per 1,000 Consumers 1940	Washing Machines Sold per 1,000 Consumers 1940
Northeast....	7,752,126	889	57	4.34	37.99	101,273	46,104	13,836	34,430	9,269	35,018	13	5	2	4
Southeast....	1,489,629	1,081	65	3.80	39.62	23,047	16,839	7,771	6,323	602	3,831	15	11	5	4
Central.....	1,891,553	888	41	4.36	38.26	27,796	13,370	5,235	3,817	597	3,917	14	7	3	2
Western.....	1,200,926	1,334	66	2.97	41.27	7,087	8,679	6,221	2,687	1,039	2,045	5	7	5	2
Nat'l Total or Average.	12,334,234	1,048	57	3.87	39.29	159,203	84,992	33,063	47,257	11,507	44,811	12	8	4	3

by Utilities and their Local Dealers for the Full Year 1940

Also, comparisons of these sales totals with the year 1939, with data on average consumption, rates, revenues, saturations, sales totals, sales people and direct sales and promotional expense in building residential load—embracing more than twelve million consumers.

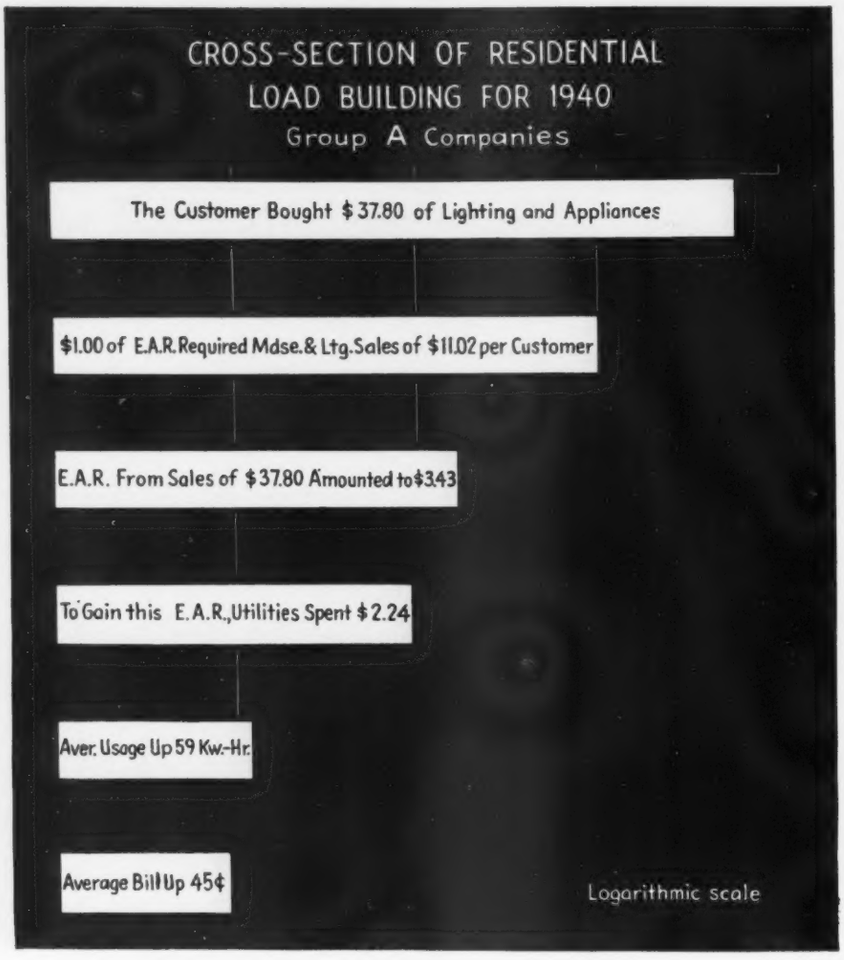
Washing Machines Units Sold By Power Cos.		Saturation Washing Machines, %	Ironing Machines Units Sold By Power Companies		Saturation Ironing Machines, %	Vacuum Cleaners Units Sold By Power Companies		Saturation Vacuum Cleaners, %	Total Sales of All Appliances By Power Cos. (Dollars)		Total Sales of All Appliances By Dealers (Dollars)		Power Co. Sales Per Consumer(†)	Annual Rev. Inc. Pwr. Co. Sales (Dollars)	No. Power Co. Salesmen and Women Building Domestic Load		Consumers Per Sales Person	Power Co. Direct Sales Expense (Dollars)	Power Co. Advtg. & Promotion Expense (Dollars)	Sales & Adv. Exp. Per Consumer(†)	Company
1940	1939	1940	1940	1939	1940	1940	1939	1940	1940	1939	1940	1939	1940	1940	1940	1939	1940	1940	1940	1940	
II—SOUTHEAST—South of Ohio River, East of Mississippi River—(Concluded)																					
222	157	.....	15	14	.....	114	100	.....	257,520	201,756	.....	.....	9.90	.....	NK 14	15	1,852	.....	.....	.....	75
		.....	.....	.....	.....	.....	.....	.....	E 40,565	E 36,717	.....	.....	E 1.62	E 10,808	7	7	3,580	.....	L 8,232	.....	76
3	3	.....	.....	.....	.....	42	24	.....	161,222	130,635	.....	.....	7.74	.....	9	9	2,330	.....	.....	.....	77
12	.....	.....	2	.....	.....	8	.....	.....	50,463	6,452	.....	.....	2.52	12,159	7	.....	2,846	12,006	4,642	0.83	78
224	95	.....	13	22	.....	46	45	.....	199,373	117,514	.....	.....	11.83	.....	N 11	10	1,530	.....	.....	.....	79
		.....	.....	.....	.....	.....	.....	.....	E 22,379	E 22,659	.....	.....	E 3.53	E 7,324	2	2	3,158	.....	L 2,778	.....	80
5,323	5,889	.....	602	758	.....	3,831	2,869	80	9,137,074	7,783,875	28,103,042	22,052,528	Y 6.43	736,212	773	716	Y 2,316	518,006	1,040,508	Y 3.44	Total or Av.
III—CENTRAL—West of Mississippi River, East of Rocky Mountains																					
608	560	.....	182	176	.....	1,436	1,540	.....	1,525,000	1,535,000	.....	.....	4.49	.....	183	192	1,860	.....	.....	.....	87
		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	116	115	2,710	.....	.....	.....	88
26	36	.....	.....	6	.....	481	697	.....	580,236	537,862	6,347,866	5,981,631	4.32	56,375	97	97	1,390	.....	.....	.....	89
79	402	.....	6	51	.....	56	195	.....	964,764	1,044,382	.....	.....	8.40	150,618	129	119	890	.....	.....	.....	90
7	65	.....	.....	31	.....	19	40	.....	150,416	189,229	4,663,987	4,503,154	1.44	37,558	70	71	1,488	126,841	175,652	2.90	91
2	7	.....	.....	.....	.....	15	19	.....	108,781	134,759	2,321,611	2,232,494	1.32	14,553	23	23	3,580	129,990	57,229	2.28	92
		.....	.....	.....	.....	.....	.....	.....	747,141	657,311	.....	.....	9.69	108,305	90	83	847	147,829	91,860	3.10	93
111	98	.....	.....	.....	.....	159	127	.....	317,600	256,300	3,587,300	3,511,000	4.28	69,594	96	132	772	.....	.....	.....	94
5	12	.....	.....	.....	.....	4	46	.....	125,661	143,242	5,072,987	3,349,056	1.79	36,966	62	95	1,133	150,124	41,353	2.72	95
571	524	31.0	32	46	1.0	124	161	68.0	523,852	504,188	.....	.....	7.94	61,320	34	35	1,938	59,967	63,888	1.83	96
98	70	.....	28	24	.....	80	75	.....	328,000	325,000	1,200,000	1,050,000	5.00	66,300	30	43	2,195	64,000	9,000	1.11	97
459	485	.....	90	72	.....	122	120	.....	775,017	842,145	.....	.....	12.70	63,961	66	66	926	(M)	81,103	L 1.33	98
276	216	.....	54	50	.....	321	344	.....	501,505	472,674	571,876	.....	11.79	38,862	56	.....	760	.....	L 15,000	.....	99
150	190	83.0	54	76	6.4	174	230	65.6	237,945	230,025	.....	.....	5.68	46,146	48	41	870	.....	J 168,074	J 4.02	100
391	454	.....	21	29	.....	285	181	.....	972,459	862,147	.....	.....	25.29	179,373	46	47	850	.....	.....	.....	101
149	193	20.5	.....	.....	.....	10	34	.....	126,934	146,834	1,155,755	1,415,281	3.38	24,233	41	56	914	21,486	132,091	4.09	102
205	185	.....	10	10	.....	107	139	.....	394,959	398,552	.....	.....	12.00	62,407	33	36	995	70,907	14,465	2.60	103
8	8	.....	2	2	.....	6	8	.....	190,185	183,782	.....	.....	6.41	48,554	7	6	4,426	13,127	.....	0.44	104
149	160	82.0	25	17	5.0	65	70	.....	197,095	183,782	.....	.....	8.17	16,186	19	18	1,268	25,824	.....	.....	105
123	54	20.0	8	14	1.0	97	76	40.0	264,872	252,765	.....	.....	11.63	36,587	20	20	1,139	41,300	19,202	2.66	106
		.....	19	18	.....	141	123	.....	161,444	172,821	.....	.....	7.72	33,296	12	14	1,744	31,300	55,678	4.16	107
128	169	80.0	21	30	5.0	95	91	80.0	315,114	302,232	.....	.....	15.40	28,000	30	30	680	49,794	63,432	5.54	108
2	9	.....	.....	.....	.....	13	6	.....	18,423	16,143	.....	.....	0.95	.....	5	5	4,896	.....	.....	.....	109
100	85	.....	21	14	.....	28	27	.....	.....	.....	.....	.....	.....	.....	12	11	1,474	.....	.....	.....	110
260	304	60.0	19	20	3.0	.....	.....	.....	175,500	154,800	200,000	175,000	11.70	18,724	9	9	1,668	22,662	12,783	2.36	111
28	28	.....	.....	6	.....	.....	.....	.....	94,684	82,356	.....	.....	8.20	10,931	7	7	1,648	12,667	2,215	1.29	112
82	79	85.0	5	7	10.0	79	70	70	68,512	72,845	.....	.....	99.20	29,565	10	10	692	8,482	18,793	3.94	113
		.....	.....	.....	.....	.....	.....	.....	45,936	42,877	.....	.....	14.02	10,000	3	3	1,088	2,625	7,405	3.06	114
4,817	4,393	Y 58.0	597	699	Y 4.5	3,917	4,419	Y 65.0	9,912,035	9,744,053	25,121,382	22,217,616	Y 11.65	1,248,414	1,354	1,384	Y 1,874	978,925	1,029,223	Y 2.74	Total or Av.
IV—WESTERN—Rocky Mountains to Pacific Coast																					
.....	.....	50.0	.....	.....	4.5	.....	.....	.....	E 861,637	E 836,065	14,000,000	14,000,000	E 1.87	J 1,665,567	150	152	3,069	.....	.....	.....	122
855	716	60.0	426	171	7.5	1,408	1,343	70.0	TT 680,381	690,448	T 4,460,505	2,270,000	TT 3.78	T 107,042	49	58	3,595	.....	.....	.....	123
125	160	82.0	118	40	2.0	113	258	80.5	1,112,678	1,005,036	.....	.....	9.64	.....	88	85	1,312	.....	.....	.....	124
223	215	.....	41	39	.....	196	220	.....	358,052	577,949	6,354,370	5,584,089	3.38	32,520	B 12	75	.....	.....	.....	.....	125
		.....	.....	.....	.....	.....	.....	.....	339,176	286,972	3,410,000	3,215,000	4.10	.....	32	30	2,592	70,000	.....	.....	126
208	122	.....	73	38	.....	1	4	.....	342,968	358,648	3,756,633	3,480,409	5.22	48,341	88	73	747	291,933	68,999	5.50	127
703	628	75.0	236	138	14.0	181	125	30.0	379,454	310,963	3,394,587	2,641,457	6.25	58,642	76	78	800	.....	.....	.....	128
242	504	.....	76	89	.....	144	163	.....	296,454	446,789	*3,648,046	*2,708,754	5.16	64,095	59	58	975	.....	.....	.....	129
11	1	70.0	.....	.....	2.0	2	7	70.0	38,678	39,360	1,300,295	1,014,175	1.48	14,928	19	18	1,370	10,000	99,190	4.20	130
232	119	.....	37	19	.....	.....	.....	.....	211,752	188,250	.....	.....	8.34	51,395	19	19	1,336	.....	.....	.....	131
68	104	75.0	32	38	5.0	.....	.....	.....	186,684	170,739	.....	.....	8.93	50,000	12	20	1,737	45,000	30,000	3.59	132
1,667	2,569	Y 69.0	1,039	572	Y 6.0	2,045	2,120	Y 62.6	3,807,914	4,911,219	40,324,436	34,913,884	Y 5.28	2,092,530	604	666	Y 1,753	416,933	198,189	Y 4.43	Total or Av.

Does not include home economists or home lighting personnel.
In territory beyond company gas mains.
B Adjusted.
E Decrease due to rate reduction.
T Major appliances only.
TT Lamp bulbs and major appliances only.
Q Includes rural.
QQ Includes irrigation and spray.
Y Straight line average.
Z Weighted average.

Company Sales Totals, Territory Saturations and Averages

Power company. Relating roughly the prevailing cost of using appliances, their present popularity and the volume of utility sales.

Ironing Machines Sold per 1,000 Consumers 1940	Vacuum Cleaners Sold per 1,000 Consumers 1940	Average Saturation Refrigerators 1940 %	Average Saturation Ranges 1940 %	Average Saturation Water Heaters 1940 %	Average Saturation Washing Machines 1940 %	Average Saturation Ironing Machines 1940 %	Average Saturation Vacuum Cleaners 1940 %	Total Appliance Sales By Power Cos. (Dollars) 1940	Appliance Sales per Consumer (Dollars) 1940	Total Annual Revenue Increase from Power Co. Sales 1940	Total Sales People on Domestic Load 1940	Consumers per Sales Person 1940	Power Co. Direct Sales Expense 1940	Power Co. Adv. & Promotion Expense 1940	Sales & Adv. Exp. per Consumer	Region
1	4	52.2	13.5	3.2	72	11.7	64.	35,096,518	5.46	2,419,169	3,738	2,469	1,738,058	1,806,741	2.19	Northeast
....	2	61.6	17.1	7.5	....	....	....	9,137,074	6.43	736,212	773	2,316	518,006	1,040,508	3.44	Southeast
....	2	54.8	12.2	3.4	58	4.5	65.	9,912,035	11.65	1,248,414	1,354	1,874	978,925	1,029,223	2.74	Central
....	2	55.4	24.6	11.8	69	6.	62.6	3,807,914	5.28	2,092,530	604	1,753	416,933	198,189	4.43	Western
1	3	56	16.9	6.5	66	7.	64.	57,953,541	7.21	6,496,325	6,469	8,412	3,651,922	4,074,661	3.20	Nat'l Total or Average


CROSS-SECTION OF RESIDENTIAL
LOAD BUILDING FOR 1940
Group A Companies
The Customer Bought $37.80 of Lighting and Appliances
$1.00 of E.A.R. Required Mdse. & Ltg. Sales of $11.02 per Customer
E.A.R. From Sales of $37.80 Amounted to $3.43
To Gain this E.A.R., Utilities Spent $2.24
Aver. Usage Up 59 Kw.-Hr.
Average Bill Up 45¢
Logarithmic scale

tion exists this year and is due to the fact that the January figures embrace the entire industry, whereas it is only the "top two-thirds" of the industry which elects to fill in and return the confidential questionnaires in time to get into this survey. This will explain why there is a difference in the two compilations, and may also explain why the companies in this survey report, in the aggregate, better performance than the industry as a whole.

To clear up one more point, Tables I and II include every participating company, but where a questionnaire was not completely filled in it could not be used for the numerous analyses as the blanks in partially completed questionnaires would distort the basic comparisons.

Trends

During the past five years most of the companies represented in this survey have appeared year after year. There is, however, a "turn-over" of ten to fifteen per cent of the group caused by companies which drop out for a year or two. Their places are taken by other companies, most of them being former participants. The general complexion of the group is therefore not too much changed and permits a few observations on important trends.

Utility appliance sales, after a 32 per cent drop in 1938, are now running 4 to 5 per cent better than the previous year. A faster recovery has characterized dealers' sales. From a drop of 8 per cent in 1938, the gain was 16 per cent in 1939, and was 14 per cent in 1940, both well above the 9 per cent gain recorded for 1937. As a result, combined utility and dealer sales (on a per customer basis) show an 11 per cent gain for 1939 and a 9 per cent gain for 1940, compared to a 4 per cent gain in 1937.

Turning to load and revenue building, we see that average usage has shown consistent gains. The gain of 9 per cent reported for 1937 has diminished to 5.5 per cent in 1939, but is now on the way back to higher levels, with 7 per cent reported for 1940. Year-to-year revenue gains follow a curve similar to usage, but of course on a reduced scale. The 3 per cent gain in the average annual bill in 1937 dropped off to a 1.1 per cent gain in 1939, supplanted by a slight improvement, to 1.2 per cent in 1940.

As sales, usage and revenue progressed along the four-year wave, what did the utilities invest in load building from year to year? In the good year of 1937 utilities increased their sales and promotional expenses by 2 per cent. During the poorer 1938, utilities threw 12 per cent more money per customer into the job. In 1939 and 1940, with operating companies on the up-grade again, utility expenses per customer declined 3.2 per cent during 1939, and in 1940 expenses per customer were further reduced by 17 per cent, some of which undoubtedly was due to a gain of 885,000 customers.

Utility Sales

Taken all together, the companies presented in Table I reported sales by their own forces of $57,953,541 of lighting devices and appliances. Last year the utility companies stated that in reality more than 27 per cent of the sales they reported as dealer sales were company sales. However, foregoing adjustments of this nature, the volume figure above amounts to $4.69 per residential customer, or a direct utility sales volume for the industry of $116,548,845.

For comparable figures on dealers' sales we must turn to Table III, constructed exclusively from questionnaires which were 100 per cent complete. Here utility company sales are reported as $4.52 per residential customer and utilities report that their dealers sold $33.28 of lighting and appliances. It is the sum of these two figures, $37.80, which is used as the basis for the cross-section chart on load building.

As shown in Table III, the Estimated Annual Revenue (E.A.R.) for company sales of $18,947,098 amounted to 63 cents per customer and E.A.R. from dealers' sales of $139,470,569 amounted to $2.80 per customer.

When it comes to E.A.R. developed from sales, utility sales are of course more productive per dollar of customer purchases and therefore a primary reason for continuous direct selling by the utility. This is demonstrated by the fact that to gain $1 of

E.A.R. through dealers, dealers' sales had to reach $11.88. On the other hand, it required only $7.20 of utility sales to produce $1 of E.A.R.

This situation continues year after year and shows that utility sales must not only set the pace for dealers' sales but must also keep sales activities pointed in directions that will bring in enough revenue to pay utility operating expenses, interest charges and dividends.

Cost

Here we advance our story by one remaining step. You now know what you have accomplished, and the final question we want to answer is: What did the job cost?

As Table III shows, these companies spent $9,403,229 for direct sales and promotion of dealers' sales in 1940. This total amounts to $2.24 per customer. So they achieved $3.43 of new revenue at a cost of $2.24, and therefore added $1 of new E.A.R. at a cost of 65.3 cents, compared to 62.7 cents in 1939 and compared to $1.05 in 1938.

Average usage went up 59 kw.-hr. last year and average annual bill increased 45 cents. Other salient points pertaining to these companies are found in the cross-section chart for Group A companies.

Utilities Reporting All Sales Through Dealers

Results show increased volume of sales, more sales required to gain E.A.R., lower E.A.R. per customer but lower cost per dollar of E.A.R. Normal gain in average usage, gain in revenue off

WE CLOSE the 1941 survey with a few comments on the Group B companies, listed in Table IV.

The tabulation is a little longer this year due to the entrance of three new companies. These companies have belonged in Table IV for a number of years, but this is the first year they sent in their questionnaires.

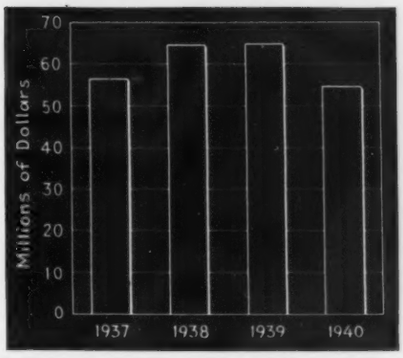
All the salient data have been reproduced in Table IV, but in making an analysis of load-building results it was necessary to limit the study to companies 140, 141, 144, 147, 148, 149, 150 and 151. Incomplete questionnaires came from other companies listed in Table IV.

Comparisons Limited

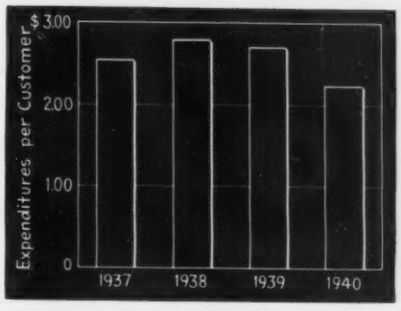
It is solely these companies which are represented in the chart "Cross-Section of Residential Load Building for 1940—Group B Companies."

It is with some reluctance that we publish this year the chart showing cross-section of residential load building for representative Group B companies in Table IV as this new chart lends itself to comparison with a similar chart published annually covering the companies in Table I. The two groups are not strictly comparable, any more than two single companies are comparable due to the necessity for designing a load-building problem to meet the specific needs at a given time of the individual company.

Yet comparisons will be drawn, and particularly between the two average bill increases of 12 cents and 45 cents. This difference is due in substantial degree to (1) rate reductions in Group B companies shown by five out of seventeen, or 29 per cent, of the companies. By comparison, only seven out of 50 Group A northeastern companies, or 14 per cent, showed rate reductions and only 3 out of 20 Group A southeastern companies, or 15 per cent.



TREND of sales and promotional expenditures by utility companies to build residential load



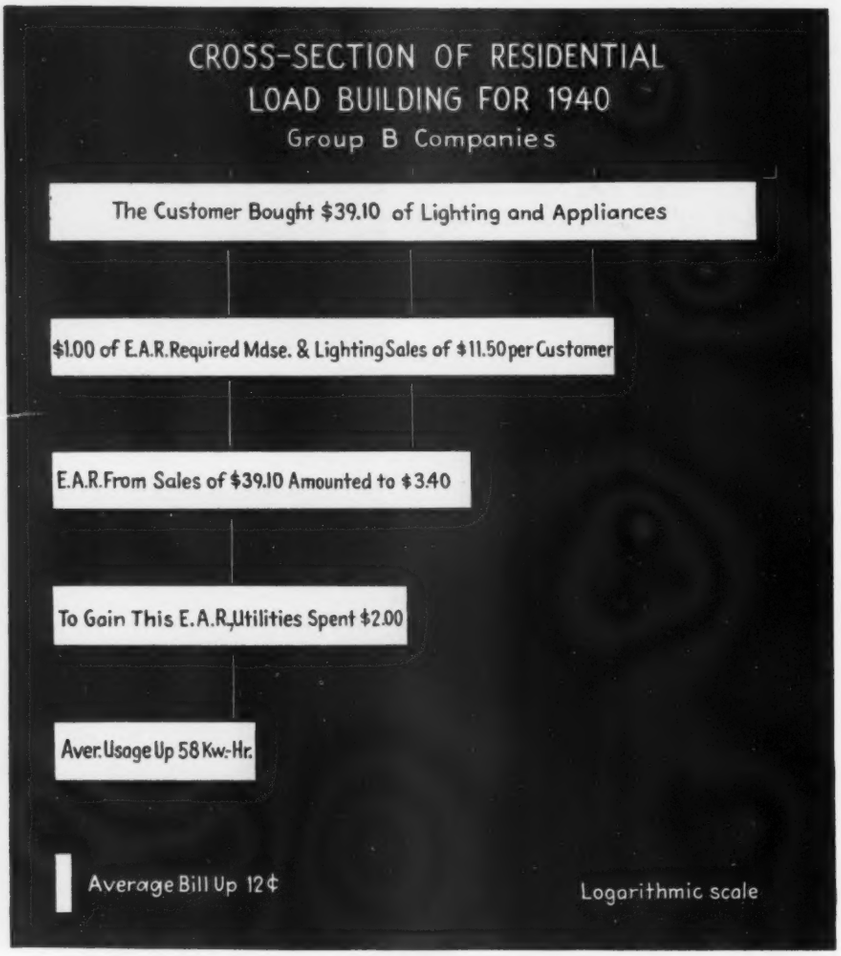
TREND of expenditures per residential customer by utility companies to build residential load

The second point is that whereas the all-industry figures show an increase in average bill of 39 cents (ELECTRICAL WORLD, January 11, 1941, page 95), the companies joining in this survey reported much larger increases. In the northeastern group (see Table I) 43 of the companies reported increases, 39 of them above the 39-cent average. In the southeastern group seventeen companies reported increased bills, fifteen of which were above the 39-cent average. Number 63 increased its average bill $3.91, and this on top of a net gain of 13,668 residential customers.

Table III—Cost to Build Revenue Through Company and Dealer Selling

Geographical Group	Number of Customers	Through Company			Through Local Dealers			Total E.A.R. per Customer	Cost per Customer	Cost per Dollar of E.A.R.
		Lighting and Appliance Sales	E.A.R. from Sales	E.A.R. per Customer	Lighting and Appliance Sales	E.A.R. from Sales	E.A.R. per Customer			
Northeast	1,986,145	$8,353,683	$1,184,120	z $0.60	$52,589,531	$5,183,213	z $2.61	z $3.21	z $1.75	$0.54
Southeast	396,388	1,822,608	327,902	z 0.83	21,408,220	2,226,727	z 5.61	z 6.44	z 3.28	0.51
Central	776,172	5,474,006	756,650	z 0.97	25,148,382	2,124,421	z 2.74	z 3.71	z 2.43	0.66
Western	1,039,165	3,296,801	355,568	z 0.34	40,324,436	2,206,154	z 2.13	z 2.47	z 2.52	1.02
Total or Average	4,197,870	$18,947,098	$2,624,240	z $0.63	$139,470,569	$11,740,515	z $2.80	z $3.43	z $2.24	z0.65

z Weighted average.


CROSS-SECTION OF RESIDENTIAL
LOAD BUILDING FOR 1940
Group B Companies
The Customer Bought $39.10 of Lighting and Appliances
$1.00 of E.A.R. Required Mdse. & Lighting Sales of $11.50 per Customer
E.A.R. From Sales of $39.10 Amounted to $3.40
To Gain This E.A.R. Utilities Spent $2.00
Aver. Usage Up 58 Kw.-Hr.
Average Bill Up 12¢
Logarithmic scale

Figures on sales volume by dealers in the territories served by the eight companies were reported as $14,948,456 and gained 21.9 per cent over 1939. Furthermore, this sales volume amounted to $39.10 per customer, which is $1.30 per customer more than was sold through the utility-dealer combined selling policy.

E.A.R.

The dealer quite naturally has his eyes fixed on his profits from sales volume and probably never heard of E.A.R., much less does he understand its vital importance to the utility company.

Thus, where a utility sales volume of only $7.20 brings in a dollar of E.A.R., it requires $11.50 of sales volume through these dealers of Table IV companies to bring in the same dollar of E.A.R. The Table IV company therefore has to stimulate the sale of 60 per cent additional lighting device and appliance volume than would be necessary if it did all the selling itself.

These companies have secured this added volume of dealer sales and they spent only $2 per customer to do it. The E.A.R. per customer amounted to $3.40, so the companies paid only 58.8 cents in 1940 for one dollar of E.A.R.

A year ago these companies were paying 80.6 cents for a dollar of E.A.R. and in 1938 they were paying $1.10. Accordingly, while efficiency of promotion has been improved per dollar of expenditure, utilities are year after year spending substantial sums of money to build load and revenue.

Table IV—Load Building Where Utility Sells Through Dealers

Growth in number of consumers, in average usage and average revenue. Average rate comparisons, expenditures by utilities to build load and utility reports of sales and saturations of major appliances.

Company	Total Residential Consumers		Av. Annual Residential Consumption		Av. Annual Residential Revenue		Av. Price Res. Service —Cents	Refrigerators, Units Sold by Dealers	Saturation of Refrigerators	Ranges Sold by Dealers	Saturation of Ranges per Cent	Water Heaters Sold by Dealers	Saturation Water Heaters per Cent	Number Power Company Sales Men and Women Building Res. Load		Advertising and Promotion Expense (Dollars)	Adv. and Prom. Exp. per Consumer (Dollars)
	1940	1939	1940	1939	1940	1939	1940	1940	1940	1940	1940	1940	1940	1940	1939	1940	1940
135	293,331	286,377	997	924	33.94	33.15	3.40	37,138	64.0	5,122	6.5	.....	.....	99	95	.....	.....
136	207,324	198,301	1,010	943	37.76	36.05	3.74	22,914	60.6	3,823	7.8	486	.7	.....	.....	*393,000	*1.90
137	G 195,400	190,199	983	921	36.22	36.55	3.68	15,044	60.	2,921	38.5	896	11.7	.....	.....	.....	.....
138	G 192,885	188,505	823	774	33.59	34.68	4.08	16,702	55.	2,549	25.	533	6.	85	70	277,635	1.44
139	176,626	169,818	1,263	1,195	31.72	31.40	2.51	19,783	85.	2,482	11.7	459	.7	32	32	.....	.....
140	124,959	120,332	1,518	1,390	P33.79	36.77	2.23	11,200	60.	6,000	28.9	3,050	10.	23	23	*122,000	0.98
141	G 93,041	84,524	1,033	986	41.11	41.07	3.98	12,763	75.	1,826	17.	599	3.	16	14	.....	.....
142	G 91,050	86,920	892	849	29.30	30.11	3.28	9,500	68.	133	.....	37	.....	2	2	18,000	0.20
143	66,910	65,353	1,036	981	46.66	45.35	4.50	5,483	55.	1,115	23.5	525	9.0	20	21	241,132	3.61
144	66,294	63,452	1,352	1,300	44.79	43.58	3.30	5,750	75.	801	18.5	199	4.3	18	13	150,000	2.26
145	G 63,121	60,457	732	728	29.28	29.04	3.99	7,544	63.	102	1.3	16	.8	17	19	.....	.....
146	62,211	61,353	855	844	42.43	42.48	4.99	6,751	63.	363	3.	22	.17	.....	.....	.....	.....
147	38,604	36,307	1,529	1,423	32.62	35.43	2.13	5,072	54.8	2,634	41.6	1,139	9.7	40	33	156,000	4.04
148	16,500	16,146	918	867	48.60	46.59	5.28	1,260	60.	470	20.	.....	.....	4	4	50,000	3.03
149	16,222	16,021	970	914	48.35	46.07	4.98	1,286	49.8	525	25.	3	1.14	.....	.....	47,955	2.95
150	G 14,682	14,116	987	932	43.16	43.07	4.37	1,500	72.	175	10.	50	5.0	.....	1	9,083	0.62
151	13,010	12,257	1,591	1,466	54.37	53.21	3.42	1,600	75.	915	57.	289	17.	.....	.....	45,131	3.47
Totals or Averages	1,732,170	1,670,438	Y 1,087	Y 1,025	Y 39.27	Y 39.09	Y 3.76	181,290	Y 64.5	31,956	Y 20.9	8,303	Y 5.6	356	327	1,509,936	Y 2.23

* Estimated. G Company has gas customers. P Decrease due to rate reduction. Y Straight line average.

Socket Meters Ganged in Breakaway Panels

Mexican utility studies the application of detachable meters grouped compactly and untamperably on a channeled panel

OFFICE BUILDING with "port-hole" windows, at left, has the new panel of socket meters serving the 24 tenants

CURRENT DIVERSION seems to be a critical problem in this area and has been met by the adoption of lead and W.P. concentric cables, protected distribution boxes and metal boxes for meters. Nevertheless, the installation of metal boxes in office buildings and modern apartment houses has been met with great opposition from the owners due to esthetic considerations and to the large space required for these installations. This phase of the problem may be met by the adoption of the detachable meter in conjunction with panels that afford protection against unauthorized access yet facilitate authorized access, use the least space possible and make a very neat appearing job.

One factor which has accentuated the problem here lately is the restriction to giving consumers more than the essential domestic and commercial service needed because of the lack of sufficient capacity of the system. Quite naturally the consumers will sign up for the allowable demand and then use four or even more times that demand. The majority of services are equipped with 5-amp. meters.

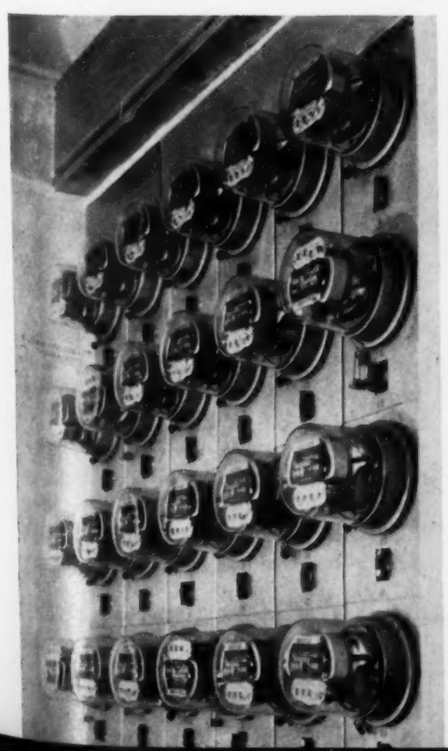
That tendency helps out admirably in the matter of standardized stocks and interchangeability, but it does aggravate the matter of overloading of the meters and the individual service runs.

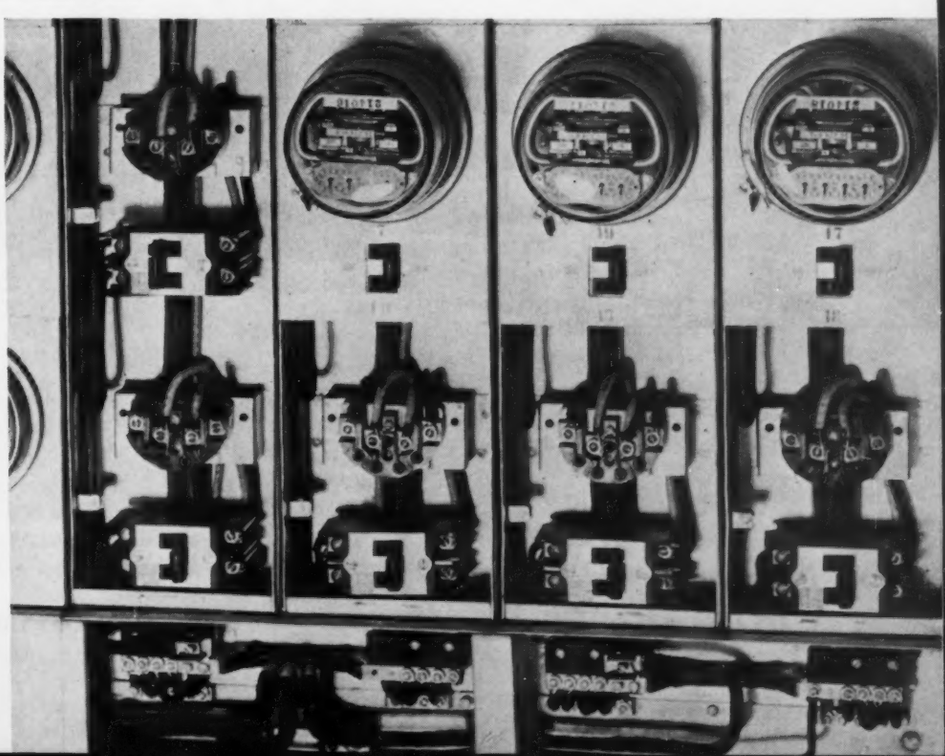
Putting it all together, it appears that a standardized panel arrangement which would carry all the meters on a systematically devised metal housing or mounting would best answer the problem of protecting the services with a minimum requirement of space.

The panel shown provides for 24 offices. A supply cable enters the center of the raceway provided at the bottom. Junction blocks under each vertical row of meters divide the supply among these vertical groups. Each individual meter panel is provided (below the meter) with a switch which also functions as a 15-amp breaker. The service runs extend from the respective meters into the upper chamber where the branch lines to the individual offices originate.

This panel scheme was worked out by the Westinghouse Electric & Manufacturing Company and it is believed that it is going to act not only as a deterrent to diversion but also to simplify meter testing, reading, replacement, seal-outs, etc.

SOCKET METERS in a battery of 24 panel units, each provided with 15-amp. Delon breaker-switch. Note that several meters have been inverted in their sockets to take care of vacancies (left). Channel along base of panel branches out the supply into six groups of four services. Several meters removed to show junction blocks and socket units (right).





Maximum Availability Aim of Switch-House Design—II

Ground fault bus, compact two-part switchgear, interlocks, special ventilation and careful structural layout contribute to emergency reliability of San Diego station B switch-house extension

H. W. EALES and H. L. HOEPPNER,† Public Utility Engineering & Service Corporation, Chicago*

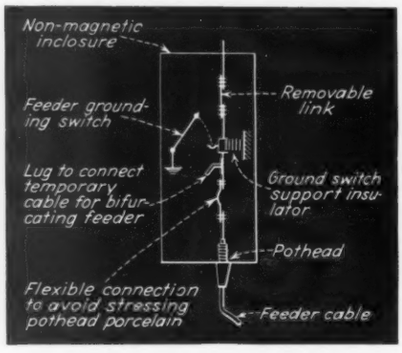
STRUCTURAL changes and adaptation of the existing conditions of station B of the San Diego Gas & Electric Company were detailed in the preceding article (ELECTRICAL WORLD, December 28, 1940).

Both the north and south buses are rated at 2,500 amp. carrying capacity and consist of bare 4 x 4 x ¼-in. square copper tube. Each phase is supported on two vertical, heavy-duty bus supports and separated by non-magnetic, interphase barriers of the same material as the inclosure. The inclosure, which is part of the fault bus system, is mounted on micarta blocks and is 23¾ in. wide, 5 ft. 9 3/16 in. high.

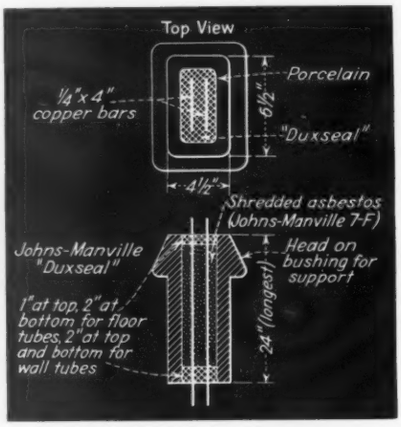
A totally inclosed bus structure was used in the new section to insure that bus faults will be phase to ground instead of phase to phase. With an open bus it was thought that fire might ionize gases and result in flashover. The inclosure also protects the bus from external hazards such as flame, hot gases and physical contact with foreign matter.

Connections from the bus to switchgear on the floor above and below are made through vertical metal-inclosed "chutes" terminating at floor and ceiling bushings, which lead directly into disconnect compartments of switchgear cubicles. These taps, as well as bus ties, are supported mechanically and electrically with the same grade of construction as the bus proper. Bus tap connection housings are 19 5/16 in. x 5 ft. 8¾ in. (same width as cubicles) and are provided with interphase barriers.

*Chief electrical engineer. †Electrical engineer.



SPECIAL feeder grounding cubicle provides means for bifurcating feeders in emergency. Makes transfer bus unnecessary



GAS-TIGHT, corona-proof floor and wall bushings carry connections from section to section

The bus tie, that connects bus section No. 2 in the old building to the extension of section No. 2 in the new building, passes through the center vestibule ventilating shaft that separates building sections. This bus extension between building sections is solid and without circuit breakers. Since, as was already pointed out, this flue will be used to exhaust smoke from the building, in the event of fire in either building section, it may be assumed that the bus itself might be subjected to high temperature conditions in the event of fire. The section of bus passing through this flue has, therefore, been inclosed in a waterproof and fireproof housing covered with special thermal insulation to insure its continued operation possibly throughout the fire.

Details of insulating this bus section extension are shown in an accompanying drawing. At this point the bus consists of two 4 x ½-in. micarta-insulated copper bars per phase, supported on micarta blocks within a non-magnetic inclosure 40⅛ in. wide x 9½ in. deep, fitted with non-magnetic interphase barriers and insulated on the outside with 1½ in. of vermiculite. Vermiculite is attached to the bus inclosure with adhesive cement. Control cable ducts passing under the bus ties and through the flues are inclosed and insulated in a similar manner.

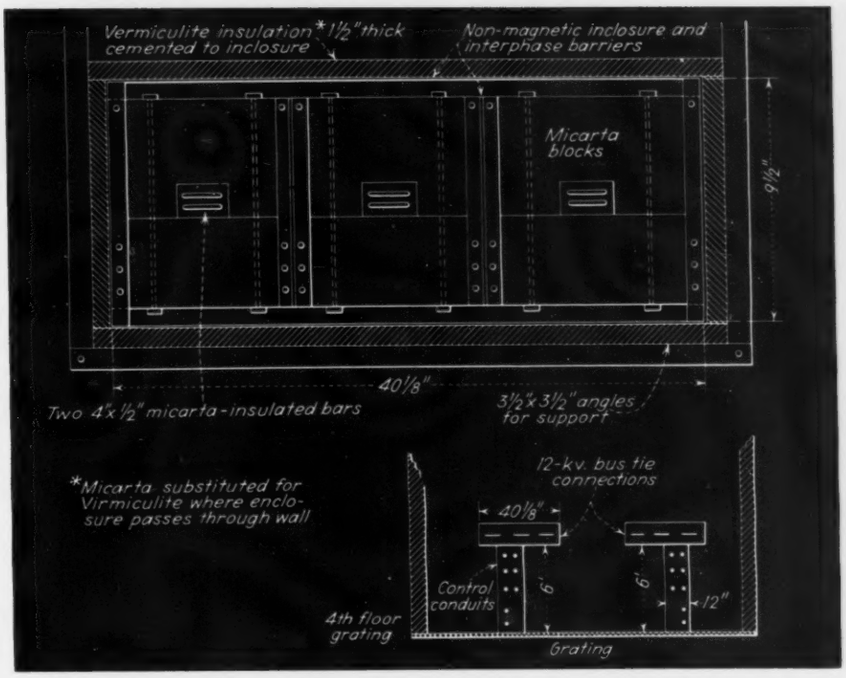
Floor and Wall Bushings

Where electrical connections pass through walls or floors special flame gas and corona-proof bushings are used. Essentially, the bushings are hollow porcelain tubes, rectangular in section, roughly 4½ x 6½ in., the longest being 24 in. in length and provided with heads to insure secure mounting. However, in each case the tubes are long enough to have ample flashover on ends emerging from the

floor or wall. Within the bushings the conductors (usually one or more ¼ x 4 copper bars) are packed in shredded asbestos. Bushings are sealed with "Duxseal" for a distance of 1 in. at the top, 2 in. at bottom, in floor tubes, and 2 in. at top and bottom in wall tubes.

A low grade of shredded asbestos, which is more conducting than higher grades, was used in order to secure a uniform potential throughout the length of the bushing. Function of the Duxseal is to hold the shredded asbestos in place and to make the bushings reasonably gas-tight to prevent entrance or escape of ionized gases and to prevent escape of CO_2 used in fire fighting. Tests on the bushings indicate that the sealing material will not run or melt under high temperature.

Where bonding rods of the ground fault bus pass through walls and floors they are incased in micarta tubing pressed tightly around the conductor. The entire assembly is carefully sealed into the wall or floor.

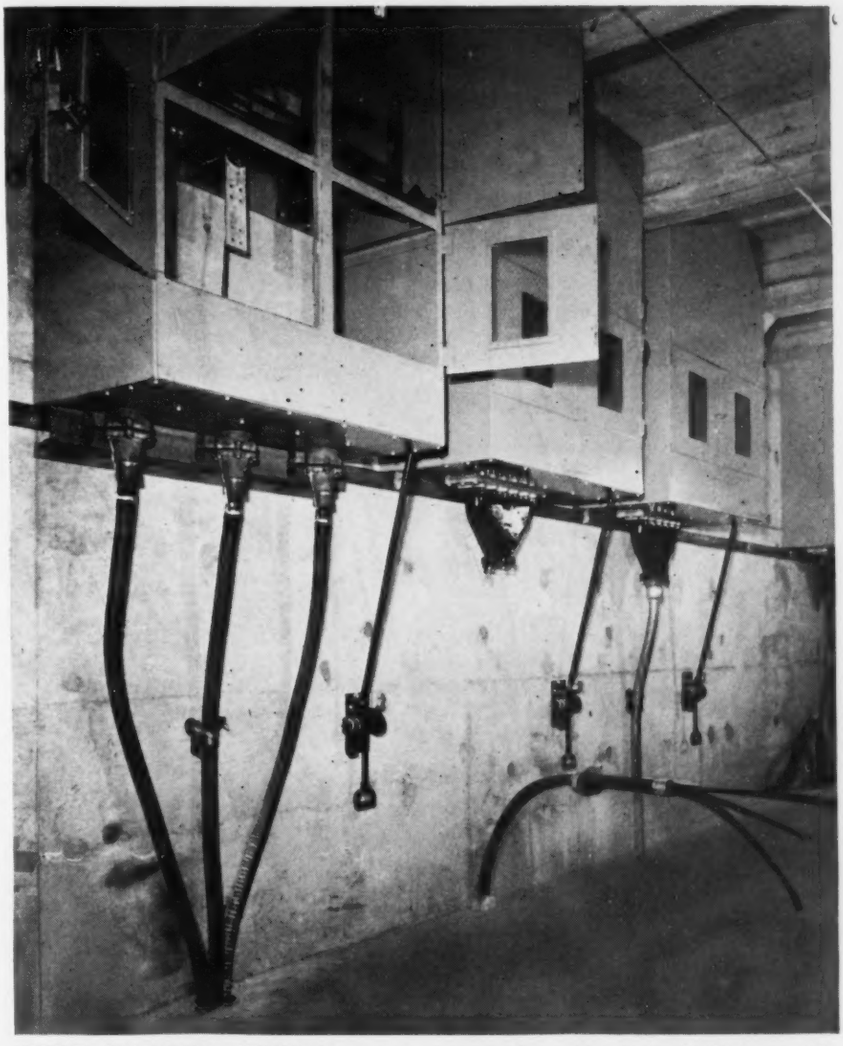


FIREPROOF INCLOSURE carries bus connector through vestibule shaft subject to smoke and flame in event of catastrophe

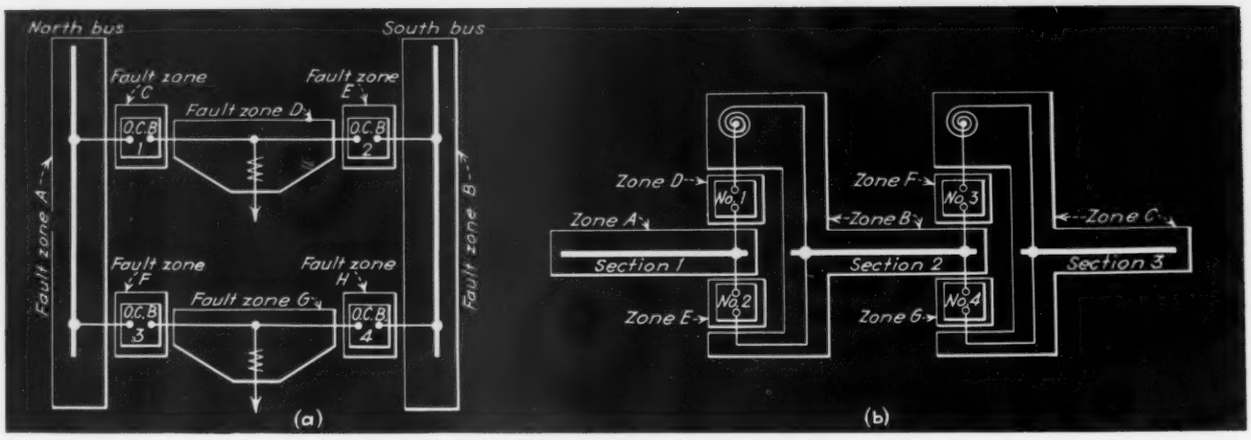
Feeder Grounding Cubicles

At the point in the basement where risers from the switching cubicles connect with feeder cable potheads, grounding cubicles of a special design have been provided. Quick-acting grounding switches are provided in these cubicles which can be closed on feeder cables (after related feeder breaker and disconnect switches have been opened) to prevent back feed. In addition, the cubicles provide operators with a means of bifurcating feeder cables. Inside the cabinet, on the circuit breaker side of the grounding switch, a removable link is installed in the feeder connection which can be removed to isolate completely the feeder cable from its normal bus connection. With this link removed a temporary cable can be brought into the cabinet and connected to a special lug ahead of the cable pothead, permitting the feeder cable to be supplied from other bus sections. A sketch of the feeder grounding cubicles is shown in an accompanying illustration.

The general scheme of ventilation for the entire switch house has already been described briefly. Fresh air is drawn into main ducts at opposite ends of the structure and distributed in separate feeder ducts to rooms on each floor. Air flows horizontally through the rooms to the center vesti-



FEEDER GROUNDING CUBICLES at point where feeder cables leave building provide facilities for bifurcating feeders in an emergency (see text)



GROUND FAULT bus system isolates faulted equipment automatically

(a) Operation of ground fault bus protection on bus and feeder zones is as follows: When fault occurs in zone A all breakers on north bus are tripped. Similarly, fault in zone B trips all breakers on south bus; zone C, all breakers on north bus and o.c.b. No. 2 on south bus; zone D, breakers Nos. 1 and 2; zone E, all breakers on south bus and o.c.b. No. 1. Faults in zones F, G and H cause operations similar to zones C, D and E.

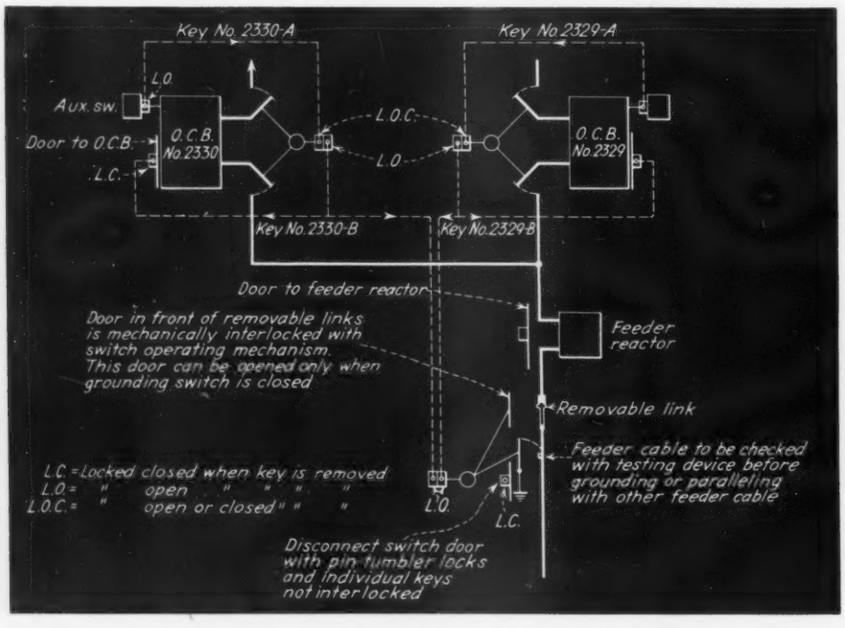
(b) Operation of fault bus protection on bus tie zones is as follows: Fault in zone A trips all breakers on bus section No. 1, including tie breakers Nos. 1 and 2. In zone B fault trips all breakers on bus section No. 2, including bus tie breakers 1, 2, 3 and 4. Fault in zone C trips all breakers in section 3, including breakers 3 and 4. In zones D and E faults trip all breakers on bus sections Nos. 1 and 2, including tie breakers 3 and 4. Similarly, in zones F or G all breakers on sections Nos. 2 and 3 are tripped, including breakers 1 and 2 when a fault occurs. (Zones F and G are connected together electrically.)

bule shaft and is exhausted to atmosphere at the roof by two exhaust fans located on the sixth floor above the shaft.

A dual drive system is provided for each of the two exhaust fans. Each fan may be driven by either a 10-hp., 900-r.p.m. motor or a 1,200-r.p.m. steam turbine, both of which are directly connected to the fan shaft so that either turns the rotor of the other. Fans are capable of exhausting 22,000 c.f.m. when motor driven, 35,000 to 37,000 c.f.m. when steam-driven. In general, the steam drive is for emergency use, the motor drive for normal operation.

Control of the steam and electric fan drive is completely co-ordinated. The steam turbine drive is arranged to start up automatically on loss of motor voltage. While the operator can start the turbine drive from the station control panel, if the fan is at standstill, transfer from steam to electric operation is automatic when steam is shut off. The operator can transfer from motor operation to steam operation at will, but he cannot start the fan from standstill with the motor by remote control or stop the motor. To do this the operator must go to the fan location and thus insure that the motor is properly started. A time delay is built into the motor circuit that allows 1½ minutes for the fan speed to drop from 1,200 r.p.m. of the turbine drive to 900 r.p.m. of the motor before the motor will cut in automatically after steam has been shut off.

Flap-type dampers are provided at the inlet and exhaust openings in each room, which are manually operated by means of chains from the corridors at the extreme ends of the buildings, as shown in an accompanying sketch. These dampers open in the direction of normal air flow. The flap-type dampers are supplemented by butterfly dampers in individual room air ducts to regulate flow of air to the room during normal conditions.


Key No. 2330-A
Key No. 2329-A
L.O.
Aux. sw.
Door to O.C.B.
L.C.
O.C.B. No. 2330
L.O.C.
L.O.
O.C.B. No. 2329
Key No. 2330-B
Key No. 2329-B
Door to feeder reactor
Door in front of removable links is mechanically interlocked with switch operating mechanism. This door can be opened only when grounding switch is closed
Feeder reactor
Removable link
Feeder cable to be checked with testing device before grounding or paralleling with other feeder cable
L.C. = Locked closed when key is removed
L.O. = " open " " "
L.O.C. = " open or closed " " "
L.O.
L.C.
Disconnect switch door with pin-tumbler locks and individual keys not interlocked

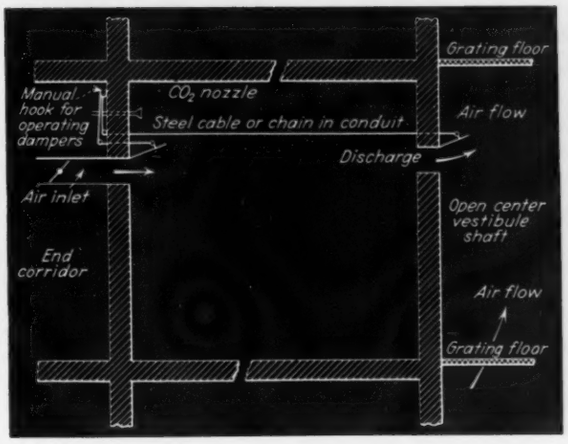
TYPICAL of interlock system used at station B switch house is system for feeder circuits

How It Works

Operation of the ventilating system, in the event of fire, would be as follows: Exhaust fans would be transferred to the higher speed turbine drive; the inlet dampers in the room or rooms affected would be immediately closed and smoke drawn from the room by the fan. The purpose of closing the inlet damper is to prevent ingress of fresh oxygen to feed the fire. It might be necessary to close both inlet and outlet dampers at the beginning of the disturbance, depend-

ing on the judgment of the operator. In the case of a large fire CO_2 would be discharged into the room from the central storage system through the permanent headers that have been provided, as shown.

Ventilation dampers and application of water or CO_2 to various chambers have been arranged for manual control. Consideration was given to making those operations entirely automatic, but it was deemed that the complete automatic operation would probably be too costly.



SEPARATE ventilation system for switch-house rooms designed to isolate fire

Fault Bus Protection

All equipment in both the old and new sections of the switch house were made a part of the ground fault bus system. All equipment is divided into fault zones and the metal inclosures and equipment in each zone, having first been insulated from the building steel, are connected to a section of the common station ground fault bus. Current transformers in each fault bus section detect variations in ground current caused by faults and act immediately through relays to trip circuit breakers that tie the faulted section to the rest of the station, isolating the fault immediately. Relays associated with the current transformers forming part of the bus fault protection schemes are located on panels near the station main control room, where the operator gets warning of the functioning of relays and the location of the fault.

All breaker cubicles, bus inclosures, bus tie inclosures and inclosures of feeder connections were mounted on insulating blocks in the new section of the switch house; however, in the older section insulation value of the concrete was considered adequate to insulate the inclosures sufficiently from the building steel.

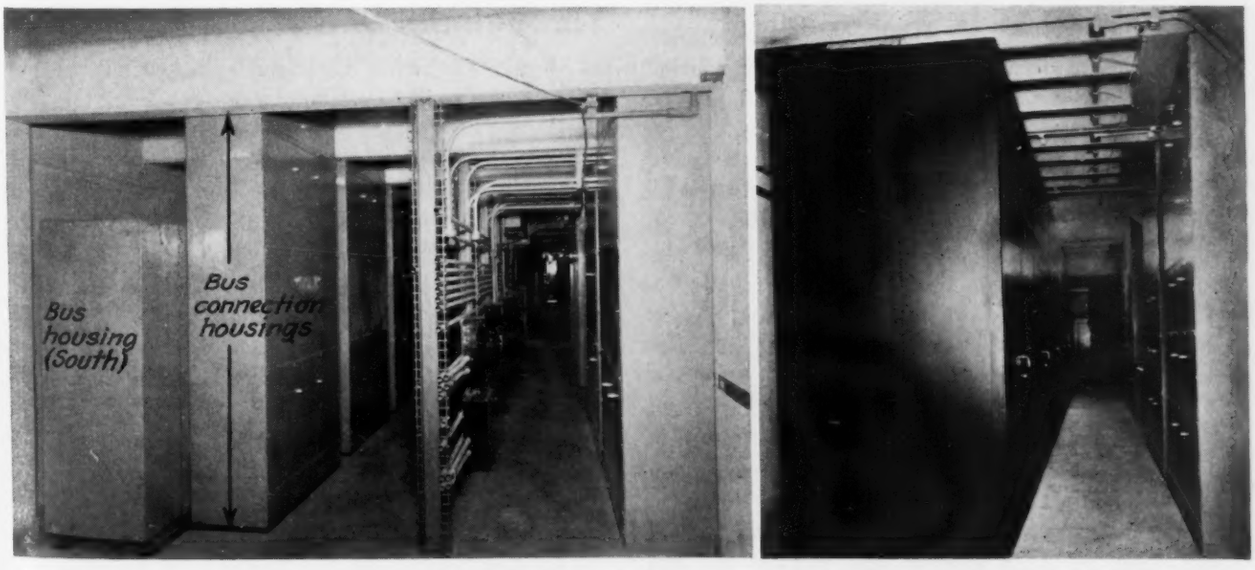
An accompanying diagram shows how ground fault zones were allocated for the bus and feeder circuits and for the bus and bus section tie switches. Captions under these diagrams detail the operation of breakers in the event of a fault on any fault section. In the diagram reference to north and south bus refers to a section of the respective buses, since each section of both buses constitutes a separate fault bus section. With the advent of a fault beyond the tee connection, circuit breakers are tripped in the conventional manner by relays on feeder current transformers.

A key system of interlocking was introduced in both the new and old sections of the building when the switch house was extended to insure the proper sequence operation of switchgear throughout the switch house.

The accompanying diagram shows the application of interlocks to feeder breaker cubicles and feeder grounding cubicles. Similar scheme is used in interlocking other equipment. In following this diagram let it be assumed that circuit breakers 2330 and 2329 and their associated disconnect switches are closed and that it is desired to open both breakers and their disconnects, close the grounding switch on the feeder at the feeder grounding cubicle and remove the link preparatory to bifurcating the feeder.

Having opened breaker 2330 by means of the auxiliary switch, key 2330-A can be removed and used to release the operating mechanism of the disconnect switches of this breaker. Upon opening the disconnects a second key, 2330-B, may be removed and used either to open the

[*Continued on page 158*]



METAL-INCLOSED south bus and connection on fourth floor. Connections are to switchgear compartments on floor above and below. Note feeder riser housings at right (left view). Immediately above bus inclosure (in picture at left) are two-part switchgear compartments housing breakers and disconnect switches (right view)

Editorials

S. B. WILLIAMS, *Editor*

Priorities for Utility Purchases

AS SHORTAGES develop in certain basic metals priorities become an acute problem for manufacturers who cannot demonstrate a direct connection between their orders and defense production. Such a situation is already developing with a number of manufacturers supplying parts or finished equipment to be used by electric utilities. If these parts or products were for delivery to a manufacturer working on Army or Navy orders it would be comparatively simple to get the necessary materials.

On the other hand, is not electric power the most universal, the most important of all raw materials used in defense production? Without it defense production for the most part would cease. If extension of power is delayed defense production is delayed.

Nor does a power company have to serve defense industry directly. There are the hundreds of sub-contractors whose continued output is necessary to maintain production of airplanes, ships, guns and other war materials.

The power companies are in every sense of the word defense suppliers, and companies selling them essential equipment for expansion, extension or maintenance of services should be accorded equal priority consideration with suppliers of direct defense material. In the former war the utilities had high priority ratings. They may not have had much trouble getting their requirements so far, but the time will come, unless these priorities are issued, when the market will not be nearly as open as it is now.

Where utilities have standardized on certain equipment, to substitute other products simply because they were the only things available is going to involve the extra expense of parts as well. Not only is that unsatisfactory to the user but, with material short, it doesn't help the supply picture any.

Might it not save time for the individual manufacturers and for the priorities division if a joint utility-manufacturer presentation were made of requirements and products? While this would not necessarily bring an automatic priority rating to all electrical suppliers, it should make it much simpler and quicker for any manufacturer who could show utility construction usage to secure the green light on needed raw material.

Shortage Based on Superposition of Defense on Normal Production

LAST FALL the Federal Power Commission saw a threatened power shortage in 1942, when defense production shall have reached its peak, of 1,500,000 kw. A report this week considerably modifies that figure, but does not reduce the emphasis placed on power demand less than two years hence.

Again we must point out that the commission, and perhaps properly so, is viewing the whole matter in a most uncompromising way. Assuming that its estimates for added power, based upon dollar volume of defense contracts, will be borne out by the customers' own estimates of power demands which F.P.C. has been compiling for some months, is it reasonable to assume, as the commission does, that these demands will be on top of normal loads?

In the first place defense production is increasing the number of shifts, but the added kilowatt-hours will increase more than the peaks.

In the second place, normal business is being displaced more and more by defense production. And as time goes on this is going to continue.

The President said in January that we had passed the point where we could superimpose defense on normal production. The latter had to give way to the former, and so it is.

Without taking consideration of any of the other F.P.C. data, it must be obvious that the commission is presenting the extreme case and one that cannot happen. So far we have not been able to discover any cause for worry over the ability of the utilities to carry the load. If anything, the present figures of the commission give one considerable assurance.

To Sell Beside or Through the Dealer

YEAR AFTER YEAR discussion as to what is the best policy for a utility to follow with respect to the merchandising of appliances goes on without either side convincing the other. In this issue, in which we carry our eleventh Appliance Sales Survey, some data for the two schools are developed which, while not conclusive, are sufficiently interesting to cause comment.

Companies selling entirely through dealers report average sales per residential customer of $39.10 in 1940, while those that sell also through their own sales forces report a combined utility-dealer figure of $37.80 per customer.

The first group report an E.A.R. of $3.40 per customer and the second group $3.43. The respective costs were $2 and $2.24 per customer, or 58.8 cents and 65.3 cents, respectively, per dollar of E.A.R.

In other words, the two groups were virtually at a stand-off so far as national averages are concerned. However, these figures are not altogether comparable.

The survey group with its own selling forces numbered well over a hundred, and the other but seventeen. Furthermore, in the direct-selling group there were more rate decreases.

It is unfortunate that data are not available showing how much of the E.A.R. actually goes down to net. Had it been possible to collect such data the results combined with the above might be much more conclusive.

One thing, however, is revealed by this year's survey —that continuous strong utility promotion, irrespective of whether a sale is made through the utility's cash register or the dealers' cash register, will secure results. In the Southeast, for instance, where a greater volume of appliance sales had to be secured in order to offset very low rates, the utility sales volume was 20 per cent higher and the dealers' sales nearly 70 per cent higher than in any other section of the country.

The figures also seem to prove that aggressive utility merchandising policy is not detrimental to dealer sales, but, on the contrary, is helpful. It sets the pace of local sales. In the Southeast, where, as shown above, the utilities did the best volume selling job, the dealers were far and away ahead of dealers elsewhere.

While these data are not conclusive as between policies, they are, nevertheless, very illuminating as to results that can and are being secured by companies that intensively cultivate the residential market. Where more of this load is needed to offset fast-growing, very low-priced industrial load the data show what can be done if the promotional money and the effort are put forth.

The Tax Dilemma

"A POINT has now been reached where the question of rate reductions depends to a large extent upon the taxes utilities under the commission's jurisdiction must pay annually." This quotation was taken from the 1940 annual report of the New York Public Service Commission, made public week before last.

Here is a dilemma both for the utilities and the regulatory commissions. But there is a way out, and that is for utilities to be encouraged to render two-part bills—one part for electrical service and the other for taxes. If, as has been contended all along, the electric utilities are in theory tax collectors, they should be able automatically through a tax clause to collect more from the customer as taxes are increased.

One company in Oklahoma has been doing that very thing for the past few months and reports customer acceptance. Should that company's taxes be increased the tax component of the bills will be raised, leaving the basic rate for electricity unchanged.

The commission in this same report said also that "it is unfair to compare rates unless there is an equality of conditions, and this applies to taxes as forcibly as to the cost of coal, wage rates and character of service."

While a two-part bill, as suggested, would not remove all of the inequalities as between localities or class of ownership, it would be very helpful in dulling the effect of an unfair public power yardstick. It would be helpful also in competitive power negotiations where decisions could be made from comparable data.

If coal clauses afforded relief a quarter of a century ago, tax clauses can afford relief today. Though they may be difficult to set up in an equitable manner, they are about the only alleviation utilities can expect from this kind of uncontrollable expense, for certainly straight rate increases at this time will meet with considerable opposition.

New Standard for Domestic Motor-Starting Currents Needed

THE POWER INDUSTRY (utilities and manufacturers alike) is looking for a new answer to the problem of motor-starting currents. There has been no accepted guide since the former unsatisfactory rules were abandoned in 1934. Motors once were found, for the most part, only in industry, but now any home that is at all electrified has several small motors that start and stop with various degrees of intermittency. If these motors could get started with no more current than it takes to keep them going the voltage dip worries of the distribution engineers would be a thing of the past and motors would no more be feared than lamps or the best-behaved of other household conveniences.

As it is, the ominously growing number of frequently started small motors is causing an ominous number of voltage-dip disturbances every time they get in motion. Distribution system design today is dictated by the flicker tolerance compatible with the extent to which the starting currents tend to swamp the steadier currents on the circuits, particularly the transformers and the secondaries. The utilities are awakening to the burden of excess distribution investment which will have to be made to meet further increase in proportion of load represented by motors. That these excess capital expenditures can be awesome is to be seen from some computations for typical distribution patterns. To give equally good (4-volt) drop for starting currents of 30 and 20 amperes per horsepower would, it appears, mean an additional outlay of about $50 for every city block in the former case. That means real money to a utility and to the customers who, in turn, pay for the service. The real question is whether it is not time really to educate the motor user that he would be better off in the long run to have a motor with more favorable starting current characteristics.

Quite naturally the utilities welcome the suggestion of the manufacturers that the old industry standard as to starting currents be reviewed in the light of the experience that has grown with growing household resort to appliance motors. An equitable solution would clear the way for unlimited electrification of the home by means of drudgery-dodging devices. It is to be hoped that such a result will be forthcoming from the negotiations now in progress.

Defense vs. Public Ownership

By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him

REMEMBER the electric power shortage? It wasn't right now, you remember, it was a shortage that was likely to come next year in certain sections of the country. And why was it coming? Because national defense requirements were apt to strain existing power capacity.

So what? Why, we plan the spending of three or four hundred millions to dam the St. Lawrence river. Obviously it won't be able to produce power or transport ships for five or more years, by which time one may hope the war and its accompanying emergency will be over. And meanwhile ships are so scarce that the notion of wasting a ship capable of crossing the Atlantic by a long trip up a river and through the Great Lakes would be vetoed if the seaway were open. So obviously it's power and not a seaway that's the national defense angle.

Never Mind Ding

Besides—we rush completion of the Santee-Cooper project, down where Ding, the cartoonist, wanted the wild life sanctuary continued, and said they wouldn't need the new power for fifty years. But of course Ding didn't know about national defense—certainly not about the emergency and the power shortage it would produce.

Then, while we are cutting all non-defense appropriations to the bone, and don't laugh, because we have this on high authority, we rush plans for additional TVAs, and would have gone further with them if Harold Ickes wasn't so determined to have his kind of power "authorities," with the "authority" vested in Harold, as told in a recent article.

Now bear in mind that this additional power is going to be necessary because lack of power is going to be a serious bottleneck in our defense program. It may handicap our defense industries. And what is No. 1 defense industry at the moment? Aluminum. This metal was the first raw material priority announced by O.P.M., momentarily at least at the head of our national defense production.

O.P.M. says manufacturers using aluminum for other than defense contracts must do without—use some substitute or go without. Why? Because every available pound of aluminum is vitally needed for defense. Aluminum is of the essence for airplanes, and it's airplanes we need, either to defend ourselves here against invasion, or to help Britain hold the invaders off until we get ready, according to the way you look at it. That is another interesting controversy, but it is being discussed at plenty length in the United States Senate, and most people have their convictions about that.

But no one doubts that airplanes are vital, and no one questions that if we need aluminum for airplanes, most other users should go without. At least there has been very little outspoken criticism except from certain workers who are reported to have lost their jobs.

So let's assume that there is a shortage of aluminum, and that the government is right about this. Or, more accurately, that there will be a shortage of aluminum.

The day after this priority order was issued Harold L. Ickes told reporters he had declined an offer of the Aluminum Company to install another plant near Bonneville. He gave his reasons at some length, but the burden of it was that the Aluminum Company was getting and would get entirely too high a proportion of Bonneville power. There might not be enough left for distribution to municipalities desiring public power systems! He may have had a weather eye cocked on the municipal election in Spokane on March 11. But it would all be pretty complexing to some historian a hundred years hence who read the President's speeches and fireside chats about our danger, and about the necessity of aiding Britain, and then read this interview explaining why Bonneville power must be reserved in case some local district already amply supplied decided it wanted to purchase Bonneville power.

This historian might wonder whether Mr. Ickes was more interested in advancing government ownership of the electric industry than in stopping Hitler. But then he would be perplexed if he read some other data which doubtless will be available in some cornerstone or other, if not in the libraries of that day. For if the data are preserved, he would find out that Ickes had denied the blessings of public power to community after community until they had knuckled down to terms which meant rather complete submission to the Department of the Interior. He would find that they had to agree not ever to expand their own facilities for producing electricity during life of the contract, for example!

Just Plain Stupid?

So he just might conclude that Ickes was more interested in power for himself and his successors than he was even in spreading government ownership, much less in stopping Hitler. Or he might reach the conclusion that, at this curious time he was investigating, the government was spreading a lot of propaganda about shortages in power and aluminum for defense purposes, when actually there was no real thought in the mind of at least one member of the President's Cabinet that there was a shortage of either!

He certainly would do a little wondering at our faculty for not letting the left hand know what the right hand was doing. Or maybe he would think we all, government and people, were just plain stupid!

NEWS OF THE WEEK

Central Power & Light Adds to Plant Capacity

Texas utility to increase Nueces Bay station with new 15,000-kw. unit and auxiliaries — Will finance $2,855,400 budget out of earnings — Takes defense precautions of facilities

Construction expenditures of $2,855,400 will be made by Central Power & Light Co., Corpus Christi, Tex., this year with power plants and distribution the two major items in the budget. Last year the utility spent $3,110,300.

Last July the company placed in operation 15,000 kw. of new capacity in the new Nueces Bay power station. This plant consists of two 7,500-kw. turbo-generators with two boilers and auxiliary equipment. A substation of 20,000 kva. was installed in connection with the power plant.

Installs New Unit

President Lon C. Hill said that one of the 7,500-kw. turbines and two boilers were removed from another plant and reconditioned for service in the new plant. One new 7,500-kw. turbine with condenser and auxiliaries was purchased and installed. Net capacity gained to company system was 7,500 kw. In addition to the plant, Mr. Hill declared, two 69-kv. transmission lines were constructed from Nueces Bay power station to nearby load centers to provide loop service.

During the year various distribution systems were expanded to take care of normal growth, Mr. Hill stated.

The following is the allocation of total construction budget:

	1941 Budget	1940 Actual
Power plants	$1,393,400	$1,855,100
Transmission lines	179,500	163,800
Substations	184,000	309,200
Distribution	1,098,500	782,200
Total	$2,855,400	$3,110,300

Expenditures will be financed out of earnings, Mr. Hill said.

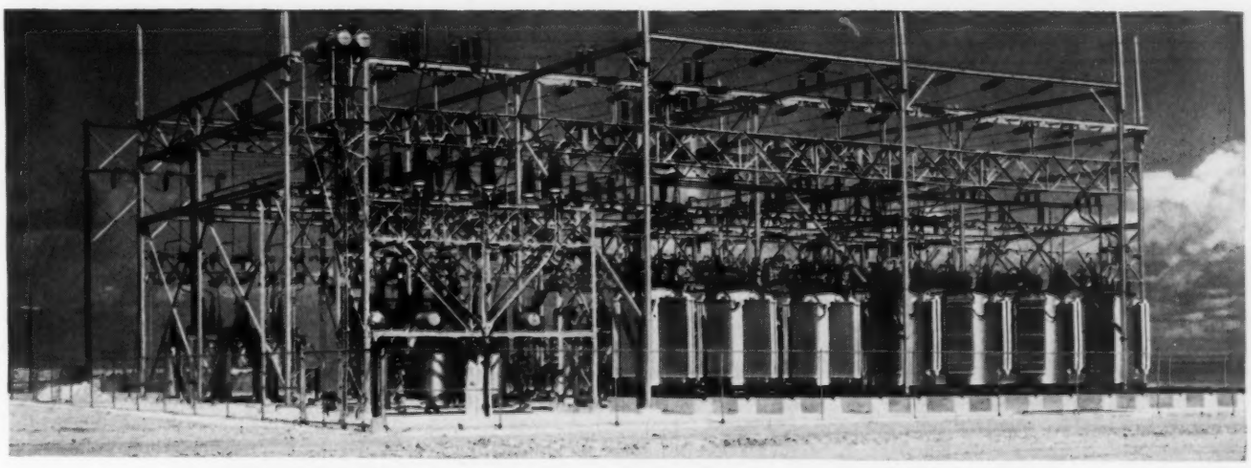
This year the capacity of Nueces Bay power station is to be increased by the addition of a 15,000-kw. turbo-generator with condenser, boiler and auxiliary equipment which was ordered last year. Construction starts this month and the equipment is to be placed in service early in 1942.

Mr. Hill said that the 69-kv. transmission system is being extended 16 miles to the Naval Air Training Station and auxiliary fields near Corpus Christi. Substations and secondary lines are being installed to supply the Naval station and additional housing in Corpus Christi to take care of personnel as well as normal growth in the city.

The distribution system in Corpus Christi is being strengthened and increased to take care of housing projects for Naval Base employees and normal growth in the city area.

Build Rural Lines

Last year the company constructed 215 miles of rural lines and expects to add 40 more this year. At the close of 1940 the company was serving five REA projects and at present three ad-



NEW SUBSTATION—Nueces Bay power station of Central Power & Light Co. at Corpus Christi, Tex., which has been enlarged to take care of rising demands for power

VIEWS PRODUCTION—William S. Knudsen, director of Office of Production Management (center), is shown production chart of General Electric's $350,000,000 of defense orders by Charles E. Wilson, left, president, and Chester H. Lang, right, chairman of General Electric's defense committee. Mr. Knudsen expressed himself as well satisfied with the company's production program when he visited Schenectady last week

ditional projects are under negotiation for 1941.

During 1940 the company added 601 rural customers to company-owned lines and expects to add 200 more this year. The average annual use in 1940 by rural customers was 1,461 kw.-hr.

Total volume of company appliance sales in 1940 was $624,281 with E.A.R. of $65,651. E.A.R. from dealers' sales was $108,422.

During 1940 the average use per residential customer was 890 kw.-hr., a gain of 10 over 1939.

Makes System Study

Early in 1940 the company engineers checked the entire integrated system operation on a manufacturer's network calculating board. From the data obtained a complete study of all transmission substation and distribution system loadings was made. As a result, the transmission and substation system arrangement serving the Corpus Christi and Rio Grande Valley areas is being revamped to provide additional capacity and loop service for increasing loads due not only to normal growth but defense projects as well, Mr. Hill stated. Also, as a result of the study, the relay system of the company is being modernized to provide greater stability and the sectionalizing of line units to provide maximum service.

Three vulnerable plants have been protected with fencing and floodlighting to reduce the possibility of sabotage. Employees' records have been checked to determine their background, citizenship and to make sure that no sabotage may occur through present employees.

Mr. Hill said that present and proposed power requirements will be served from the company's integrated power system and expansion of the Nueces Bay power station. It is estimated that the present defense program will reach a peak early in 1942, at which time the reserve generating capacity will be about 15 per cent.

To insure against a power shortage, the company is increasing the Nueces Bay station by installing a 15,000-kw. turbo-generator-boiler unit to be in service early in 1942. The company is also increasing 69-kv substation and transmission facilities to provide loop service from the station to load centers on the integrated transmission system.

•

General Electric Plant Tour Made by Knudsen

With more than 60 per cent of the floor space of the Schenectady plant of General Electric Co. devoted to defense work, William S. Knudsen, director of the Office of Production Management for defense, declared that he was much impressed with the progress being made and that it compared favorably with what was being done by other manufacturing plants throughout the country.

Mr. Knudsen visited the Schenectady plant last week, inspecting the factory and research laboratory, accompanied by President Charles E. Wilson and E. F. Johnson, in charge of aircraft, tool and ordnance production under Mr. Knudsen.

NEWS BRIEFS

SUMNER T. PIKE, SEC commissioner, has suggested that the states be encouraged to permit life insurance companies to invest in utility common stocks. His suggestion is based on disintegration of holding companies, thus throwing open large-scale investment in operating company equities.

GEORGIA POWER has started a company-wide competition to improve its safety record. Divisional vice-presidents are sponsoring a divisional accident prevention contest. The high scoring division will receive an award to be known as the W. E. Mitchell safety trophy. Employees of the winning division will be given a dinner and the division safety chairman will receive a trip or other recognition.

SCORES OF BUSINESS GROUPS, trade associations and civic bodies strongly opposed the St. Lawrence seaway and power project at a public hearing last week in New York held by the port protection committee of the New York Port Authority. Spokesmen said that the project would have little or no value as a part of the national defense program.

FPC HAS ISSUED another of its "power shortage" reports, this time saying that demand for power is growing more rapidly than the utility systems expected. FPC estimates that in 1942 a total of 800,000 kw. of additional capacity will be needed in addition to that now on order to insure against a shortage.

W. C. MAINWARING, head of the merchandise division of the B.C. Electric Railway Co., has been loaned to the federal government to serve in the capacity of assistant to Walter P. Zellor, national chairman of the 1941 War Savings drive.

ALL EMPLOYEES of Georgia Power & Light Co. who enlist or are drafted in military service will receive 16⅔ per cent of their regular salaries during such period of military service. J. F. Bailey, president, has assured employees that they will not lose their seniority and will have their places back with the company when their terms of service expire.

Iowa Utility Undertakes Long-Range Expansion

Two parts of program made public, with third project still under discussion — Iowa Electric Light & Power to install a new boiler and build a new 115,000-volt line

General Manager F. C. Chambers of the Iowa Electric Light & Power Co., Cedar Rapids, has announced that his company is about to launch a long-range program of expansion to cover a period of several years. Only two parts of the program were made public, but it was inferred that a third project would subsequently be disclosed when details were complete.

Plans call for the immediate addition of a second 300,000-lb.-per-hour boiler in an extension of the boiler house recently completed at the Cedar Rapids plant and the construction of a new 115,000-volt transmission line from Cedar Rapids to Belle Plaine, which will be extended to Marshalltown in 1942.

Needs More Capacity

Immediate necessity for the new boiler house extension arises from a two-fold cause, it was stated: First, the rapidly increasing load, which this year touched a peak of 55,000 kw., was met only by the use of all available equipment. While a 15,000-kw. turbine is shortly to be added at Cedar Rapids station and a 5,000-kw. Diesel-electric plant will remedy the situation for a time, it is expected that by the time the new unit will be completed the system demand will again be approaching the limit of available capacity. Second, many of the boilers in the Cedar Rapids station are approaching the end of their useful life and their retirement will soon become a matter of necessity.

Contracts for the boiler have been signed with the Springfield Boiler Co. and orders have been placed for auxiliary equipment. Bids for the construction of the new building will be taken as soon as the specifications can be completed, probably within 60 days.

The proposed 115,000-kv. transmission line between Cedar Rapids and Belle Plaine, which is about 30 miles west of Cedar Rapids, marks a departure from the company's 33-kv. transmission system. For some time the company is said to have had difficulty in handling the load on the so-called "west Line." A particularly heavy load center exists at Belle Plaine, where a tap is made to serve the properties of the Iowa Electric Co. to the south. It was considered impractical to rebuild this line and maintain service. Therefore the new line will be constructed on a new right-of-way and operated in parallel with the existing line.

A new 7,500-kw. substation will be built about 6½ miles north of Belle Plaine to step voltage down from 115,000 to 33,000 and a new 33,000-volt line will be built from this point to Belle Plaine. It is expected to extend the new 115,000-volt line to Marshalltown in 1942.

The 115-kv. line will be of wood-pole construction and will carry No. 2/0 composite cable conductors. Full line will be of H-frame design with 660-ft. spans and 55 to 65-ft. Western red cedar poles. The new line is calculated to carry a load of 15,000 kw.

•

Charges High Taxes Prevent Rate Cuts

A point has now been reached where the question of rate reductions depends to a large extent upon the taxes that utilities must pay annually, the New York State Public Service Commission stated in its annual report.

"The time-worn adage that one cannot eat his cake and have it is still true and applies with equal logic to attempts to increase taxes upon utilities while at the same time demanding that rates be reduced in order to benefit consumers," the report stated.

It was found that during the past decade rates have been cut, but taxes have more than doubled and other costs are up, taxes have curbed further rate reduction, certain utilities have reached the point where they cannot pass tax increases on to their customers, even when they might be legally entitled to do so, and utility rate comparisons involving areas where tax burdens differ are neither fair nor valid.

The commission found that taxes have increased at a greater rate than revenue.

•

Detroit Edison to Spend $14,000,000 for Expansion

Detroit Edison Co. will spend approximately $14,000,000 this year on a construction budget which is the largest since 1930. Harry A. Snow, controller, stated that it probably will not be necessary for the company to issue securities to finance the budget.

The principal item of importance is the installation of a 75,000-kw. turbo-generator set at Delray power house No. 3. Line extension and meters are planned for 28,000 new customers. The company is now serving more than 90 per cent of the farms in the territory. Mr. Snow said that the company does not expect that there will be any power shortage in the territory for the next two or three years.

UNIT CABINETS AID DEFENSE—Central Maine Power's new substation at Bath utilizes assemblies of relays and instruments in metal-clad cabinets designed by the manufacturers for rapid installation and ease of maintenance. All the control equipment required for the connecting link between transmission and distribution circuits is housed in this way. A similar installation has been made at Auburn

Independent Authority Favored for Northwest

President Roosevelt takes indirect hand in feud over control of Bonneville and Grand Coulee power projects — Area wants local control and makes "home town" proposal of five-man board

President Roosevelt has taken at least an indirect hand in the growing feud within the New Deal over a permanent operating set-up for the vast multiple-purpose federal development of the Columbia River in the Pacific Northwest. By blunt inference the President has hinted for creation of an independent authority similar to TVA to take over and operate Bonneville and Grand Coulee dams—not simply distribution of their power, but their other purposes as well.

Legislation carving out a second huge TVA is reportedly being prepared under the direction of David Lilienthal, director of TVA and a leader in the group seeking a set-up in the Northwest similar to that operating in the Tennessee Valley. Such a bill would be in sharp contrast to a measure already before Congress carrying the hopes of Secretary of the Interior Ickes, which proposes creation of an administrator for the Bonneville-Grand Coulee power distribution. This administrator would report directly to Mr. Ickes; operation of the two dams would be left in the hands of their builders—the Army Engineers in the case of Bonneville and the Bureau of Reclamation, also an agency under Mr. Ickes, in the case of Grand Coulee.

Senator Norris Backs Idea

Backing the TVA idea for the Northwest, it is understood, is Senator George W. Norris, godfather of the New Deal power cult. Whether Mr. Ickes has any support for his administrator set-up outside his own department is not certain.

The President indirectly entered the picture at a press conference in his reply to a question regarding the possibility of the Army Engineers taking over distribution of Bonneville power for defense. Mr. Roosevelt denied the report, but added that he thought he knew what was behind it. Continuing, he said the report was just a revival of the old idea that they had when TVA was set up.

At that time, he explained, TVA was created to look after a great many things in the watershed, not just power. It was thought then that if TVA worked out well the idea might be extended to other places. More recently this program has come to a head again and they thought the Arkansas Valley would be the most logical and proper place to try the TVA idea. They also thought that the Columbia River, because of a number of federal projects there, would be a good place.

The whole question, he concluded, is not just a matter of the War Department nor just a matter of power, but is a much broader affair.

Legislature Prepared

The President indicated that legislation for the Columbia watershed has been prepared and that it also includes the Puget Sound watershed.

While this jockeying for position was under way in Washington, a third factor entered the Northwest picture in the form of a "home town" proposal for local control of public power in that area. This scheme is to set up a board of five members, three named by the PUD's in the area and two by the federal government, to direct distribution of Bonneville and Grand Coulee energy. Any plan giving control of power distribution in the Northwest to local agencies is not considered to have much chance in Washington.

•

High Pressure Used on Spokane Election

The full weight of government agencies and bureaus is being employed to swing the municipal ownership election to be held in Spokane on March 11.

The Federal Power Commission, which instituted an investigation in the Pacific Northwest before the November election to defeat Initiative 139, held up the report of the inquiry until last week, it is said. The report took sharp exceptions to so-called "political activities" of the five utilities.

Reports from Washington state that the FPC report was rushed through last week so it could be inserted in the Congressional Record, which is now being sent to residents of Spokane by frank. Reports also state that Governor Sprague and the Mayor of Portland are protesting to Secretary Ickes for the limiting of power available to Aluminum Co. of America on the basis that such a decision is keeping industries away from the area. It is said that Mr. Ickes has assured Spokane that sufficient power will be made available to the city from the two government projects on the Columbia River.

It is stated in Washington reports that Bonneville Administrator Paul J. Raver and his associates are making nightly speeches favoring the Spokane proposition. Government employees evidently are paying no attention to the Hatch Act by working to push over the Spokane vote.

•

Northwest Utilities Attack FPC Report

Sharp issue has been taken by utilities in the Pacific Northwest against the report of the Federal Power Commission on its investigation of political expenditures by five companies. The report disclosed that $1,037,516 had been spent and approximately one-half had been charged to operating expenses.

The commission said that investigation of the accounts of Northwestern Electric Co., Pacific Power & Light Co., Portland General Electric Co., Puget Sound Power & Light Co. and Washington Water Power Co. showed "improper accounting, inadequate records and deliberately falsified vouchers."

Paul B. McKee, president of Pacific Power & Light, said that "everybody knows that the power companies of the Pacific Northwest have been forced to defend themselves for the last five years against incessant blitzkrieg attacks by Mr. Ickes' Bonneville administration and other promoters of socialized power who seek to destroy efficient power systems that have been developed by private enterprise and pioneering private investment."

Frank McLaughlin, president of Puget Sound Power & Light, denied any political activity as such or the practice of improper accounting. He called for clarification of the issue "as smoked-up by 'smudge pots' of public ownership proponents."

•

First Grand Coulee User

The Nespelem Valley Electric Cooperative, Inc., a REA-financed public power agency in north central Washington, will be the first power customer for Grand Coulee power. The cooperative has signed a contract for the purchase of 100 kw. of prime power with delivery to start in May.

Associated Trustees File Plan with SEC

Trustees of Associated Gas & Electric System filed with the SEC this week a plan of corporate simplification and equitable distribution of voting power of General Gas & Electric Corp.

The plan calls for the merger or consolidation of General Gas & Electric and Southeastern Electric & Gas Co. into a new company. The subsidiaries of Virginia Public Service Co. will be merged or consolidated with it. Eastern Power Corp. has been dissolved since December 31, 1940. It is proposed to merge into the new company the subsidiaries of Eastern Shore Public Service, also Southern Electric Utilities Co.

Unsecured indebtedness of Southeastern will be converted into new common on the basis of 20 shares of new common for each $100 principal amount of indebtedness and accrued interest. The 4 percent scrip of GENGAS will be assumed by the new company and holders can receive cash or 20 shares of new common for each $100. Prior-preferred holders will get one share of new preferred or 20 shares of common, the $6 series 1.2 shares of preferred or three shares of common, the $7 series will get 1.3 shares of new preferred or three shares of new common, the $8 shares will get 1.4 shares of new preferred or three shares of new common. Class A and Class B common will get three shares of new common for each 20 shares held. The preferred will be given the right to vote and elect two out of seven directors.

•

Gets Show-Cause Order on Accounting Methods

Federal Power Commission has directed the Indiana Hydro-Electric Power Co., Hammond, Ind., a company controlled by Midland United Co., to show cause at a public hearing to begin in Chicago on April 14 why the commission should not order that adjusting entries be made in the company's books of accounts in accordance with recommendations of the commission's staff.

Included in the requests transmitted with the commission's staff report is one that an amended plan be submitted for disposing of certain amounts shown in the report as established in Account 107, Electric Plant Adjustments. The company is directed to show cause why such disposition should not be made in its accounts.

ADEQUATE WIRING—Miss Elizabeth Rece, member of the Rocky Mountain Electrical League's Adequate Wiring Bureau and director of the Denver Electric Institute, in the modern electric kitchen of the institute, where 25,000 women are expected to receive the adequate wiring story through a series of talks and demonstrations

U. G. I. Seeks to Hold Units as Investment

Indications that United Gas Improvement Co. will strive at every point in integration proceedings before the SEC to retain as much of its system as the broadest interpretation of the act will permit were given at resumption of hearings in Washington.

A surprise came into the proceedings when W. C. Mason, U.G.I. counsel, indicated that U.G.I. plans to argue that its 61 per cent ownership of Connecticut Light & Power Co. stock be considered an investment along with its $56,000,000 investment in Public Service Corp. of New Jersey. He declared that U.G.I. had no thought of attempting to sustain a claim for the right to retain its interest in utility companies in Arizona, New Hampshire, Tennessee and Kansas, along with certain non-utility properties, particularly the so-called "ice properties" in the Southwest.

Sharp disagreement with the views of Mr. Mason was expressed by SEC Chairman Frank and Commissioner Healy in retention of the Connecticut properties as an investment. Mr. Mason had argued that Connecticut law forbids outside control of a utility in the state. Mr. Frank held that the utility act provision that ownership of 10 per cent or more of stock constitutes control and that the Connecticut statute did not negate the utility act.

SEC indicated that arguments would be heard on why the commission should not enter show cause orders for U.G.I. to divest itself of all its holdings other than those in a single geographical integrated system and any additional ones for which the company could prove big B.

It was evident that the SEC was ready to act to order separation of isolated properties as promptly as they come up in the hearings.

U.G.I. is appealing for a reversal of SEC's findings in the Columbia Gas & Electric case which denies permission to retain both gas and electric properties in a single integrated system. U.G.I. claims that its gas and electric properties in the tri-state area around Philadelphia are a single integrated system, both historically and from an economic point of view.

•

Rocky Mountain Group Promotes Adequate Wiring

Rocky Mountain Electrical League is to undertake a large-scale program of promotion of adequate wiring in its territory of Colorado, New Mexico, Wyoming and portions of Montana and South Dakota, according to George E. Lewis, manager.

The message of adequate wiring will be carried by motor caravan, radio, newspaper and billboard advertising, pamphlet, sticker and letter and public talks, according to T. M. Foulk, chairman of the league's wiring bureau. It is estimated that 25,000 women will hear the message through the Electric Institute in Denver. The advertising program is being directed by F. R. Jamison, Public Service Co. of Colorado.

E.E.I. Trustees to Meet on SEC Registration

Trustees of the Edison Electric Institute are scheduled to meet March 13 in New York City to discuss registration of E.E.I. with the Securities and Exchange Commission as a service organization under Section 13. Lack of a quorum at the Chicago meeting last month prevented action at that time.

The question of the status of independent utilities, not now under SEC jurisdiction, should E.E.I. register, has been raised in some quarters. SEC feels that registration of E.E.I. would not affect independent utilities or bring them under commission jurisdiction. SEC feels that it should not issue a show cause order for registration until trustees have had an opportunity to act first.

•

Hartford Electric Light Ordered to File Data

The Federal Power Commission has ruled that Hartford Electric Light Co. is a public utility within the meaning of the Federal Power Act and has ordered that the company file with the commission within 90 days the data and information required for compliance with FPC's order on uniform system of accounts and filing of information on the original cost of its electrical facilities. The company had challenged the commission's jurisdiction.

In overruling the company's contention, the FPC emphasized that its accounting regulations do not oust the accounting regulations of the state and that in accounting matters Hartford Electric Light is subject to both state and federal regulation.

•

Power Salesmen Become Fluorescent Conscious

Although connected load may decrease when a business place turns from incandescent to fluorescent lighting, it does not follow, in the over-all lighting service picture, that revenue will suffer appreciably or at all. That was the summary impression to be taken from talks and discussions on fluorescent lighting at the meeting of the Interstate Power Club in New York this week.

Longer hours of use compensate for the lower energy demand. By itself, fluorescent is not always, nor is it very often, the best kind of lighting. It should be combined with incandescent for best results. In commercial places the ratio in watts connected should probably be four incandescent to one fluorescent. Apart from its value as a light source, fluorescent has a great usefulness to the utility in that the interest it has aroused in store owners and operators provides an excellent opener to the promotion of other commercial uses of services.

Talks by J. E. Murtha, Consolidated Edison, and Paul Every, Ebasco Services, gave comprehensive coverage to the subject of selling fluorescent to commercial establishments. Mr. Murtha told of a recent study of 110 installations in New York and Mr. Every presented similar data from Dallas, Tex. Henry Clum, Jersey Central Power & Light, told how easy it was to sell fluorescent to industrial customers and his thesis was supported in enthusuastic fashion by B. J. Jensen, Public Service Electric & Gas. Recent developments in fluorescent lamps were described by Ralph Morrison, General Electric, and R. E. Clisdell, also General Electric, gave information on the use of protective lighting in industry.

Lighting Fixtures to Get Tags of Certification

Following nearly a year of study, the first group of residential lighting fixtures produced under the Specifications-Certification Program of the American Lighting Equipment Association has been received and will begin examination by the Electrical Testing Laboratories.

Incorporating the I.E.S.'s recommended practice for the illumination performance of residential ceiling luminaires, the A.L.E.A. program marks the first effort of the residential lighting fixture industry to produce certified fixtures complying with authoritative illumination specifications, identified as such to the public by means of a certification tag.

•

To Sell 12,000 IES Lamps

Georgia Power Co. has set a sales quota of 12,000 I.E.S. lamps for 1941.

COMING MEETINGS

Southeastern Electric Exchange—Engineering and operation section, DeSoto Hotel, Savannah, Ga., March 13-14; annual conference, Bon Air Hotel, Augusta, Ga., May 1-3; J. W. Talley, executive secretary, 303 Haas-Howell Bldg., Atlanta, Ga.

Oklahoma Utilities Association—Annual convention, Tulsa, Okla., March 17-18. Kate A. Niblack, secretary, 625-626 Biltmore Hotel, Oklahoma City, Okla.

Northwest Electric Light and Power Association—Annual meeting, Business Development Section, Davenport Hotel, Spokane, Wash., March 27-29. Daryl B. Leonard, chairman, Pacific Power & Light Co., Yakima.

Edison Electric Institute—Annual sales conference, Edgewater Beach Hotel, Chicago, Ill., March 31-April 3; annual convention, Buffalo, N. Y., June 2-5. Major H. S. Bennion, managing director, 420 Lexington Avenue, New York.

American Society of Mechanical Engineers—Spring meeting, Atlanta, Ga., April 1-3; semi-annual meeting, Kansas City, Mo.; June 16-20. C. E. Davies, national secretary, 29 West 39th St., New York, N. Y.

National Accounting Conference—American Gas Association-Edison Electric Institute, Netherland Plaza Hotel, Cincinnati, Ohio, April 7-8.

Midwest Power Conference—Fourth annual meeting, Palmer House, Chicago, Ill., April 9-10. Charles N. Nash, conference secretary, Illinois Institute of Technology, 3300 Federal St., Chicago, Ill.

Maryland Utilities Association—Spring meeting, Lord Baltimore Hotel, Baltimore, Md., April 18. G. F. Jones, secretary, Potomac Electric Power Co. Building, Washington, D. C.

Electrochemical Society—Spring meeting, Cleveland, Ohio, April 16-19. Colin G. Fink, secretary, Columbia University, New York, N. Y.

Greater New York Safety Council—Annual safety convention and exhibit, New York, N. Y., April 22-25. Greater New York Safety Council, Inc., Lincoln Building, 60 East 42d St., New York.

Missouri Association of Public Utilities—Annual convention, Elms Hotel, Excelsior Springs, Mo., April 23-25. Jesse Blythe, assistant secretary, Merchants Bank Bldg., 101 West High St., Jefferson City, Mo.

American Institute of Electrical Engineers—Great Lakes District, Fort Wayne, Ind., April 23-25; North Eastern District, Rochester, N. Y., April 30-May 2; summer meeting, Toronto, Canada, June 16-20. H. H. Henline, national secretary, 29 West 39th St., New York, N. Y.

Illuminating Engineering Society—Pacific Division, second annual lighting conference, Pacific Gas & Electric Co. auditorium, 245 Market St., San Francisco, April 25-26. William P. Bear, general chairman, 245 Market St., San Francisco.

Arkansas Utilities Association—Annual convention, Arlington Hotel, Hot Springs National Park, Ark., April 28-29. R. E. Ritchie, secretary, Post Office Box 551, Little Rock, Ark.

Association of Iron and Steel Engineers—Spring conference, Youngstown, Ohio, April 28. Brent Wiley, managing director, Empire Bldg., Pittsburgh, Pa.

National Electrical Manufacturers Association—Spring meeting, The Homestead, Hot Springs, Va., May 11-15. W. J. Donald, managing director, 155 East 44th St., New York, N. Y.

National Fire Protection Association—Annual meeting, Royal York Hotel, Toronto, Canada, May 12-17. Robert S. Moulton, technical secretary, 60 Batterymarch St., Boston, Mass.

National Electrical Wholesalers Association—Annual convention, The Homestead, Hot Springs, Va., May 18-22. E. Donald Tolles, managing director, 165 Broadway, New York, N. Y.

Pacific Coast Electrical Association—Annual convention, Hotel del Coronado, Coronado, Calif., May 21-24.

Empire State Gas & Electric Association—Electric operating group, Van Curler Hotel, Schenectady, N. Y., May 23. George H. Smith, secretary, Grand Central Terminal, New York, N. Y.

National Association of Purchasing Agents—Annual convention, Chicago, Ill., May 26-29. G. A. Renard, executive secretary-treasurer, 11 Park Place, New York, N. Y.

American Society for Testing Materials—Annual meeting, Palmer House, Chicago, Ill., June 23-27. R. E. Hess, assistant secretary, 260 South Broad St., Philadelphia, Pa.

Missouri Valley Electric Association—Engineering Conference, Continental Hotel, Kansas City, Mo., March 27-28; rural and sales conference April 14-15; Spring accounting conference May 22-23, also Continental Hotel, Kansas City, Mo. I. D. Pettegrew, director, 1527 Sharp Bldg., Lincoln, Neb.

Power Output Rises Slightly for Week

Power production for the week ended March 1 scored a slight advance over the preceding week, reflecting higher industrial activity. This was the second consecutive advance over the preceding week and runs contra-seasonal at this time.

Total output of the electric industry for the week was 2,825,510,000 kw.-hr., an advance of 14 percent over the same week last year, according to figures of the Edison Electric Institute. Output for the week was approximately 26 percent over that of the 1939 period.

Notable among the advances was the percentage gain in the Southern States, where textile and war industries have been quite active. New Army posts also are adding to local utility loads. The West Central region also showed a larger gain over last year than in the preceding week. Other sections reported smaller gains, while Rocky Mountain remained unchanged.

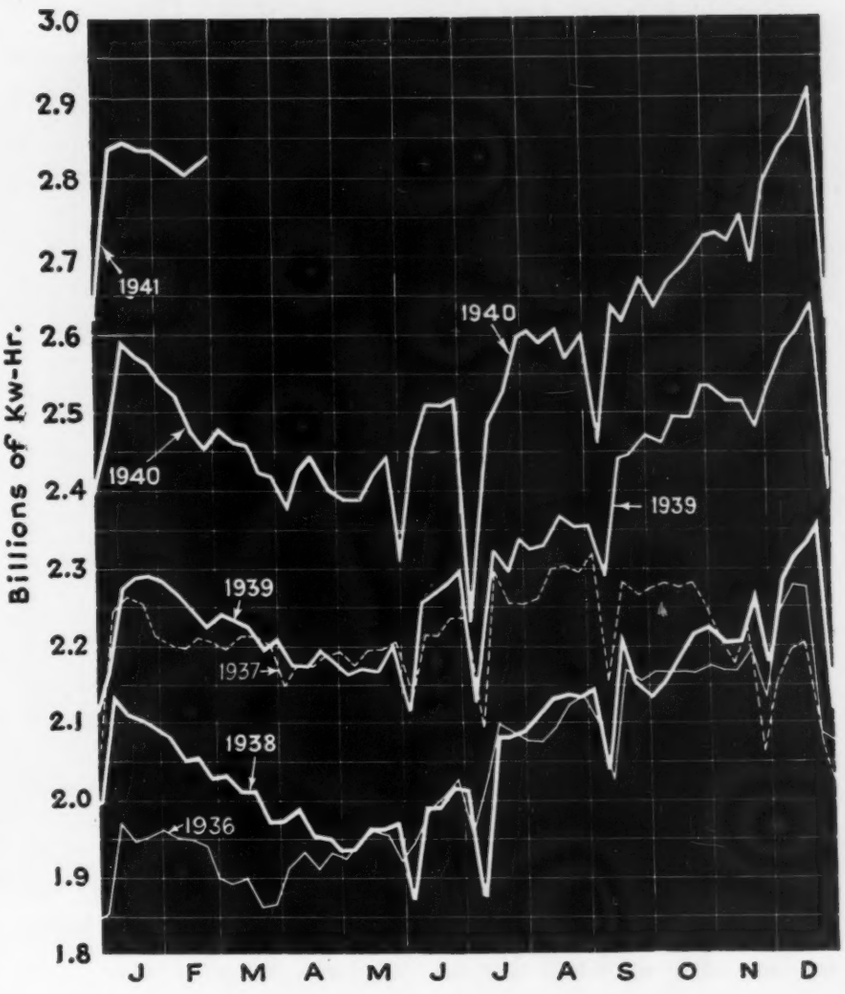
With the period of longer daylight becoming more pronounced the lighting load of the utilities normally grows less. This is not expected to have any great effect this year since the defense power load is gaining.

Weekly Output, Millions Kw.-Hr.

1941		1940		1939	
Mar. 1	2,825	Mar. 2	2,479	Mar. 4	2,244
Feb. 22	2,820	Feb. 24	2,455	Feb. 25	2,226
Feb. 15	2,810	Feb. 17	2,476	Feb. 18	2,249
Feb. 8	2,824	Feb. 10	2,523	Feb. 11	2,268
Feb. 1	2,830	Feb. 3	2,541	Feb. 4	2,287
Jan. 25	2,830	Jan. 27	2,566	Jan. 28	2,293
Jan. 18	2,844	Jan. 20	2,572	Jan. 21	2,290
Jan. 11	2,835	Jan. 13	2,593	Jan. 14	2,270
Jan. 4	2,705	Jan. 6	2,473	Jan. 7	2,169
1940		1939		1937	
Dec. 28	2,623	Dec. 10	2,404	Jan. 1	1,998

Per Cent Change from Previous Year

	Week Ending		
	Mar. 1	Feb. 22	Feb. 15
New England	+13.3	+16.7	+14.0
Middle Atlantic	+10.6	+14.5	+11.7
Central Industrial	+16.7	+17.4	+16.5
West Central	+10.7	+ 8.6	+ 8.8
Southern States	+17.5	+14.8	+13.3
Rocky Mountain	+10.7	+10.7	+ 7.5
Pacific	+10.9	+12.7	+13.2
United States	+14.0	+14.9	+13.5



Pennsylvania to Aid Rural Electrification

The Pennsylvania House has voted 204 to 0 in adopting a resolution pledging its co-operation with the farmers in an effort to secure for them an extension of rural electrification. The resolution further pledged to resist and defeat any attempt to destroy or minimize the benefits of the Rural Electrification Act of 1937.

The resolution came about through the fight between farmers and the Pennsylvania Power & Light Co. in which the former recently filled postholes as rapidly as utility employees dug them.

•

Will Vote on City Plant

The Edgerton, Wis., Common Council has voted to submit to a referendum vote at the April 1 election the following question: "Shall the city of Edgerton continue the proceedings to acquire the electric utility property of the Wisconsin Power & Light Co. actually used and useful for the convenience of the public?"

•

Home Lighting Data Sheets

The Illuminating Engineering Society has published the first series of Home Lighting Data sheets, giving complete descriptive data on actual lighting installations which embody both interesting treatment and good lighting practice. These sheets will supplement the society's general lighting data sheets, of which seven series have already been published, covering commercial and industrial lighting. Subscriptions for the current series of either of these publications may be entered at the society's headquarters, 51 Madison Avenue, New York City. Rates are $1 per series to members and $2 to nonmembers.

REA Projects to Use Possum Kingdom Power

Electric power will be supplied at cost to fifteen REA projects in a territory within a 100-mile radius of the Possum Kingdom Dam by the Brazos River Conservation and Reclamation District, according to Lewis Mims, chairman of the board of directors of the district. The transmission lines of the fifteen REA projects will be joined into one system and the districts will be incorporated to carry out the enlarged plans of the distribution.

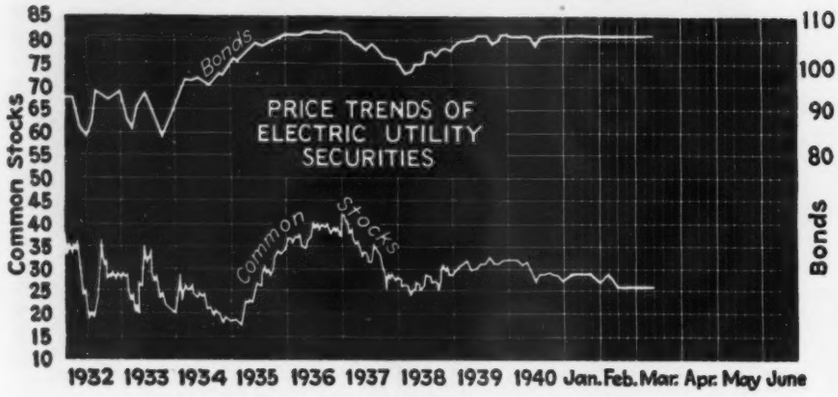
Offers to buy the entire output of the dam by Texas Electric Service Co. were rejected by the directors.

•

Will Spend $3,500,000

The Commonwealth of Massachusetts plans total expenditures of $3,500,000 for power plant equipment at state hospitals in several parts of the state.

Utility Stocks Turn Upward; Bonds Dip


PRICE TRENDS OF
ELECTRIC UTILITY
SECURITIES
Bonds
Common Stocks
Common Stocks
Bonds
85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10
110 100 90 80
1932 1933 1934 1935 1936 1937 1938 1939 1940 Jan. Feb. Mar. Apr. May June

Slight changes in the price of light and power stocks during the past week brought the "Electrical World" index to 25.8; last week, 25.6; last year, 31.0. Bonds dipped to 105.6 from 105.9 the preceding week; last year, 106.0

Pacific Gas Plans Larger Bond Issue

Pacific Gas & Electric Co. is considering increasing its contemplated financing from the total of $65,000,000, as registered with the Securities and Exchange Commission, to about $110,000,000. The company would also sell the entire issue to underwriters instead of disposing of part of it privately as previously planned. If this is done the issue will constitute one of the largest recent single pieces of corporate financing. Proceeds from the sale of the proposed securities would be used to the extent of approximately $100,000,000 to redeem at 110 on June 1 about $91,400,000 of 4 per cent series G bonds. The remaining $10,000,000 would represent new-money borrowing.

Public Service Co. of Indiana and its wholly owned subsidiary, Dresser Power Corp., have filed a declaration with the SEC regarding the proposed transfer of the assets of the subsidiary to the parent company and the retirement of the subsidiary's outstanding bonds. To obtain the necessary funds to retire the bonds Public Service proposes to issue and sell $4,650,000 of 3½ per cent first mortgage bonds, series B, due March 1, 1971, to John Hancock Mutual Life Insurance Co. at 104¾.

Kansas Electric Power Co. has filed an application regarding the proposed issuance and sale of 26,450 shares of 5 per cent cumulative preferred stock, $100 par value. The company proposes to offer to holders of its outstanding 7 per cent preferred stock and 6 per cent junior preferred stock the privilege of exchanging their shares for the new 5 per cent preferred stock on a share-for-share basis plus cash equal to the difference between the redemption price of the outstanding stocks and the initial public offering price of the new 5 per cent preferred stock. Shares not taken under the exchange offer are to be offered publicly through underwriters.

Cities Service Co. has filed a declaration regarding the proposed acquisition of its 5 per cent debentures, due 1950, 1958, 1963, 1966 and 1969, in an aggregate amount not exceeding 5 per cent of the $167,107,400 aggregate principle amount outstanding as of December 31, 1940, namely $8,355,370. The company proposes to make the acquisition from time to time during the next year in the open market either through brokers and dealers on securities exchanges or in the over-the-counter markets or at private sales.

•

Central Hudson Plans to Refund Bond Issue

Ernest R. Acker, president of the Central Hudson Gas & Electric Corp., has announced that the company had filed a petition with the New York Public Service Commission for authority to issue and sell $13,265,000 principal amount of first mortgage 3 per cent bonds, due in 1971. The purpose of the financing would be to refund a like amount of the company's outstanding 3½ per cent bonds.

Arrangements have been made, Mr. Acker stated, for the sale of the new securities to a group of institutional buyers at 105 and accrued interest.

•

N. J. Public Service Cuts Dividend on Common

Board of Directors of Public Service Corp. of New Jersey has declared a quarterly dividend of 55 cents per share on its common stock, payable on or before March 31 to stockholders of record March 7. During 1940 the dividend was 60 cents per share per quarter. In view of all the uncertainties existing at the present time and the probability of increased taxation, the board thought it wise to be conservative in this respect until more information is available about the future.

The board also declared the regular monthly dividend of 50 cents a share for April on its 6 per cent cumulative preferred stock, payable April 15 to stockholders of record March 14.

•

Program to Simplify Washington Unit

Program designed to simplify the corporate structure of Washington Railway & Electric Co., 46.27 per cent of the voting control of which is lodged in North American Co., is under consideration by the management, Alfred G. Neal, president, revealed in his annual report to stockholders.

Mr. Neal pointed out that discussions "had not yet advanced to the stage where a definite plan can be submitted to regulatory bodies and stockholders."

•

International Hydro Plan Broadened by SEC

The SEC has recently broadened the scope of its corporate simplification proceedings instituted against International Hydro-Electric System in June, 1940, so as to include New England Power Association and subsidiaries.

Named with New England Power Association as parties to the proceedings were Massachusetts Power & Light Associates, North Boston Lighting Properties, Rhode Island Public Service Co., Massachusetts Utilities Associates and its common voting trust.

•

Will Increase Investments

SEC has approved the program of Cities Service Co. to increase its investment in certain subsidiaries, engaged principally in the oil and gas business, by a maximum of $12,000,000 over the next year.

Utility Reports

	Net Income 1940	1939
*Arkansas Power & Light.	$1,154,435	$1,265,153
*Birmingham Electric	474,764	624,492
*Carolina Power & Light†	3,998,801	2,224,069
*Florida Power & Light†..	2,285,945	1,428,709
*Idaho Power†	1,486,917	1,516,779
*Kansas Gas & Electric†..	1,587,516	1,191,532
*Louisiana Power & Light†	1,007,400	1,047,429
*Mississippi Power & Light†	416,158	446,205
*Montana Power and subs†	3,923,694	3,249,830
*Nebraska Power	1,673,756	1,782,711
*New Orleans Public Serv†	2,627,341	1,947,072
*Northwestern Electric† ..	460,051	623,830
**Utah Power & Light‡...	2,025,799†	1,410,419
*Washington Water Power and sub.†	2,818,664	3,041,658

*Twelve months ended December 31.
†Preliminary.
‡Including Western Colorado Power.

STOCK ONLY 5 ITEMS

FOR 80%

OF DISTRIBUTION CUTOUT REQUIREMENTS

Two housings and three doors to solve most distribution fuse cutout problems. That's the G-E formula for cutout flexibility—and here's how it works:

First, clamp any G-E 50-amp indicating cutout housing (5 or 7.5 kv) on the crossarm. Then you're ready for any one of *three different kinds of cutout service*—depending on the door you use.

1. If a single-element cutout is needed, just hook on a single-element door. It has the selective feature for either indicating or drop-out operation and it fits either housing.

2. If a reclosing cutout is needed, just hook on a two-element door. It contains the entire reclosing mechanism. The door restores service through a second fuse link one second after a temporary fault blows the first link—and *it can pay for itself the first time it operates.*

3. Disconnects can be handled the same way. The disconnect door, with flexible blade and indicating and isolating features, fits either housing.

Any way you figure it, you'll find these two housings and three doors are a cost-cutting combination. Five items fill 80 per cent of all distribution cutout needs. In addition, there's a 100-amp 2-housing 3-door combination to take care of the other 20 per cent. Complete cutouts and separate doors are stocked for prompt deliveries.

Write for Bulletin GEA-3448. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

406-4

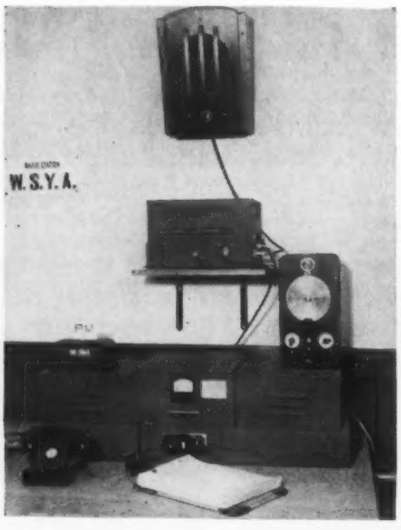
OPERATING PRACTICES

Radio Cuts "Stand-by" Time

By R. R. HABBERLEY
Superintendent of Distribution, United Electric Light Company, Springfield, Mass.

To release a trouble crew of two men and equipment from a large share of stand-by time, the United Electric Light Company obtained a license from the Federal Communications Commission to establish a radio station with call letters "WSYA" for a 25-watt Western Electric fixed transmitter and two 15-watt portable mobile transmitters of the same make, all operating on a frequency of 39,860 kc. The engineering in this case did not involve the use of anything more than standard police equipment. The service building is located near the geographical center of the operating territory. A 75-ft. pole supporting a co-axial radiator gives us sufficient height to render good two-way communication over a radius of 8 miles. Under favorable conditions of elevation we have talked two-way up to 20 miles.

Our program provides for an ultimate set-up of four portable mobile transmitters, which will give us two-way communication between our service building and a general trouble crew, a small overhead construction crew, a cable splicing crew and the superintendent's car. Three other supervisors' cars will be equipped with receivers only, with the thought that one of the two-way trucks would be on the emergency job and available for the supervisors' use. The installation makes better use of our existing personnel and equipment, giving us the equivalent of an additional field crew at considerably less cost per year plus better emergency coverage. It is estimated that the savings effected will pay for the radio installation in 3½ years.



HEADQUARTERS set at general service building

LINE CREW talks with base of operations from field

Dynamite Technique for Setting Poles

For setting poles in submerged areas, swampland and soft plastic soil the Northern States Power Company uses a dynamiting technique which has proved not only fast and effective but also safe and free from the pole breakage frequently encountered where dynamite is used. In building a line from Blair to Alma Center, Wisconsin, recently, for example, 231 out of a total of 360 poles were set with dynamite without breaking a single pole.

"Shooting In" Procedure

The accompanying sketches show the steps followed in "shooting in" a pole by this method. After a shallow hole 1 to 2 ft. deep and the diameter of the pole has been prepared a 1¼-in. pipe, with conical ground point, is driven to the depth desired for the bottom of the pole. The ground point is then loosened by inserting a rod into the pipe and the pipe pulled up about 1 in. to free it from the point. A charge of dynamite (see table) primed with a long electric blasting cap is next pushed down to the bottom of the pipe, uing a wooden stick. The charge is held in place by the stick and the pipe withdrawn, allowing the lead wires to slip through.

With the charge in place the pole is then set squarely in the preliminary hole and guyed four ways and the charge fired (from a distance of at least 40 ft.). The explosion creates a pear-shaped pocket, and as the gases rush up around the pole it settles into the cavity. If necessary, the earth is tamped around the hole to fill the pocket completely. If the charge does

What SPIRAKORE TRANSFORMERS in the Larger Sizes Mean to You

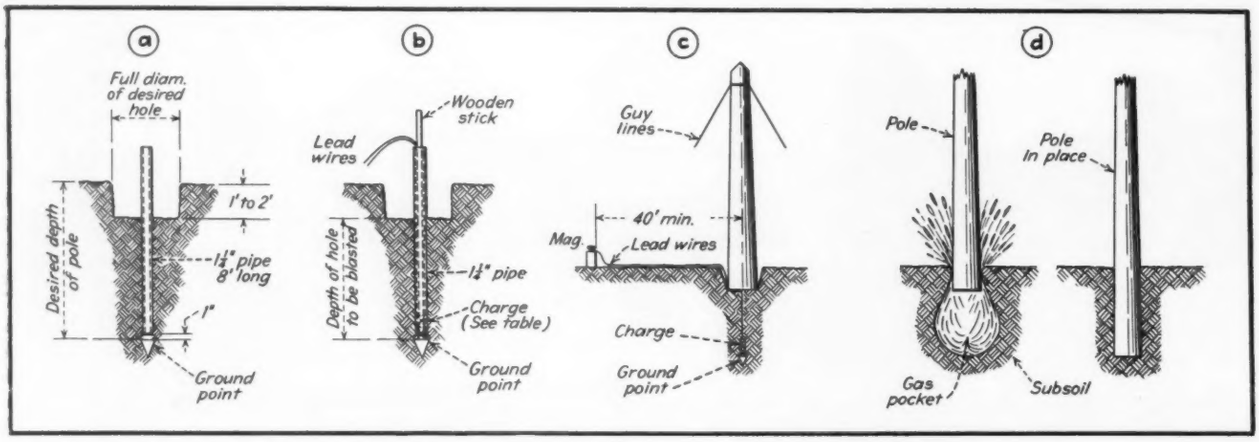
Reduced Investment—The market levels for distribution transformers being sold today average 15 to 20 per cent lower than in the period just prior to the introduction of the Spirakore design. The rapid extension of Spirakore to the larger sizes is helping to maintain these lower market levels in the face of increased raw-material and manufacturing costs.

Improved Characteristics—The advantages resulting from the remarkable core enable the designer to make improvements throughout the entire transformer, in part to reduce the size and weight, and in part to better the impulse characteristics, improve the thermal characteristics, and decrease exciting current. The result—easier handling and improved operation. General Electric, Schenectady, N. Y.

Specify Spirakore transformers—designated TYPE HS

GENERAL ELECTRIC

402-26-5100



STEPS in setting poles in swampy soil with dynamite—(a) Drive 1¼-in. pipe to desired depth of pole. (b) Push charge into pipe with wooden pole. (c) Set and guy pole in shallow hole. (d) Explosion forms pear-shaped hole into which pole drops.

not set the pole to the desired depth the operation is repeated, driving the pipe along the side of the pole.

The ground point, previously mentioned, is conical in shape and has a hole in its base (which is up) that is large enough to fit loosely over the end of the 1¼-in. pipe. No attempt is made, of course, to recover points, which are made by a local concern at a cost of about $0.16.

A modification of this technique is used in setting screw-type swamp anchors in cases where the anchor hits some obstruction before it is down to the desired depth. The charge is driven, in the manner described, from a point on the surface estimated to be above the obstruction. A light charge is fired and while the ground is still loose the anchor is driven home.

The company also uses dynamite to loosen the ground around poles that are being pulled out of the ground by either a caterpillar truck or with jacks. Half a stick of dynamite is placed on opposite sides of the pole and about 16–18 in. from it. Explosion of the charge loosens the earth, permitting the pole to be pulled up with ease.

Suggested Charges* for Setting Poles with Dynamite

Soil	Hole Depth	Cartridge 60% Dynamite
Swamp with underlying muck	5–6	1½
Swamp with underlying muck and rock	4–6	2
Sand and water	5½–7	2½–3

* Table based on experience of several men familiar with this method. Table is only suggestive; soil and depth of hole must be considered.

Photographic Standard Guides Lamp Removal

By C. TROUT
General Foreman Transmission Maintenance Dept., Cincinnati Gas & Electric Company

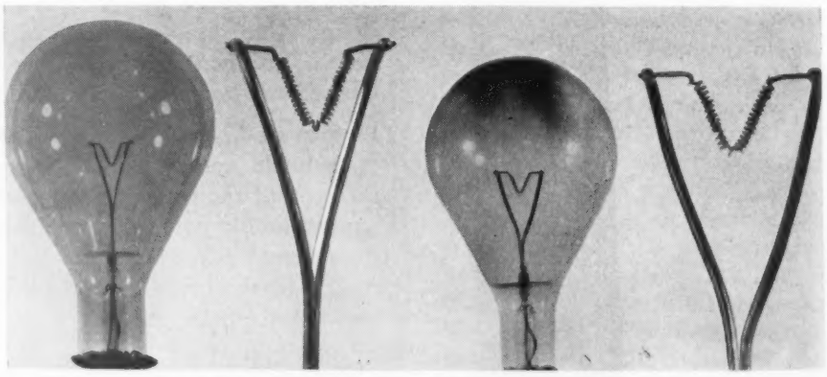
Outgrowth of tests undertaken by the Cincinnati Gas & Electric Company to determine the lumen output of street light lamps throughout their life has been the development of a unique photographic comparison method of detecting lamps due for replacement. Adoption of this replacement method as a part of routine street light maintenance has reduced lamp burnouts 27 per cent during the first year of use, while increasing total lamp replacements only 2 per cent.

During the tests mentioned various size street lamps were placed in racks and burned to destruction. Photographs were taken of the lamps and filaments at specified intervals corresponding to the measurement of lumen output. These tests revealed that the filament coils began to deteriorate visibly and to separate at approximately the same time that lumen output began to decrease rapidly.

This also proved to be the point in the life of the lamps at which filament burnout started.

Using pictures of the test lamps and filaments taken during this period of deterioration as indicators, street light lamps on the Cincinnati system are now replaced by maintenance men at the same time that street light glassware is cleaned. Most of the lamps are inspected while inoperative.

However, in downtown Cincinnati the boulevard lights are cleaned from 11 to 7 p.m. while lamps are burning, due to traffic conditions. The inspector examines the burning filaments by using a welder's glass. Lamps replaced under this method at the time of cleaning total 45 per cent of all replacements during the first year of use.



NEW LAMP—600-cp., 6,000-lumen, 20-amp. street light lamp

READY FOR REMOVAL—600-cp., 6,000-lumen, 20-amp. street light lamp

Note clean glass and compact filament in illustration at left. The illustration at the right is used as a guide for lamp replacement. Note filament separation and lamp darkening

№ 1799 VARNISHED-CAMBRIC POWER CABLE

RIGHT OFF THE SHELF

Save Time

by Ordering These Stock Items

This type cable can be operated at 85 C—often saving copper. Well suited for power feeders

HERE is a G-E power cable that was made standard because it has performed well. Stocks of popular varnished-cambric types and sizes were built, and there are now some 75 items that you can get *fast*, right off the shelf.

By ordering standards you save time, eliminate the bother of specials, and get prompt delivery—of a high-quality, *proved* product.

WHAT THIS CABLE IS

No. 1799 is essentially the same as the previous G-E standard varnished-cambric, which had a 40-year outstanding service record. But on heat resistance it is much superior. Cable with No. 1799 can be run at a conductor temperature of approximately 10 C higher. This, of course, means savings in copper, particularly on heavy currents.

Other No. 1799 v-c items are also in stock: transformer and apparatus leads for 750, 5000, 7000, and 13,200 volts; motor leads, switchboard wire, and line wire.

OTHER OFF-THE-SHELF ITEMS

In addition, too, we have large stocks of Versatol braided, Flamenol, tellurium parkway, and tellurium portable cable—all standards that have become standard because they have performed well. Investigate the advantages in their use; if time means anything, they'll save money—and they'll give you the best of service. For more details and prices, get in touch with a G-E distributor or G-E office. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

502-2-1200

75 Items in Stock

Conductor Size, Awg or 1000 Cir Mils

SINGLE-CONDUCTOR

BRAIDED	LEADED
600 Volts	**600 Volts**
14	4
12	2
10	
8	0
	00
12	0000
10	
8	250
	350
6	500
4	750
2	**3000 Volts**
1	6
	4
0	**5000 Volts**
00	6
000	4
0000	2
	0
250	00
300	0000
350	
	250
500	500
750	**6000 Volts**
1000	2
3000 Volts	0000
8	
6	**BRAIDED**
4	**5000 Volts**
2	8
	6
0	4
00	2
0000	
	0
4000 Volts	0000
6	500

THREE-CONDUCTOR, LEADED

600 Volts	3000 Volts
12	2
10	500
6	**5000 Volts**
2	8
	6
0000	4
500	2
3000 Volts	
8	0
6	00
4	0000

Porcelain Disconnects Solve Space Problem

By T. W. JOESTING
Superintendent of Electric Distribution, Municipal Public Utilities, Owatonna, Minn.

In the course of a recent improvement and expansion program on our system five feeder circuits, formerly distributed overhead, were replaced with ten 2,400-volt delta feeders in duct lines. In the course of the work the problem of providing some circuit disconnecting means for each circuit that would be safe, economical and practical presented itself. The old overhead circuits had been equipped with disconnecting-type potheads, which also served as circuit disconnects.

Available space for circuit-disconnecting switches, in the only logical location, was a section of wall exactly 19 ft. 6 in. long in the basement of the power plant directly under the main switchboard and adjacent to the cable distributing vault. The accompanying illustration shows how this limited space was used in evolving the circuit-disconnecting arrangement finally adopted for the new circuits.

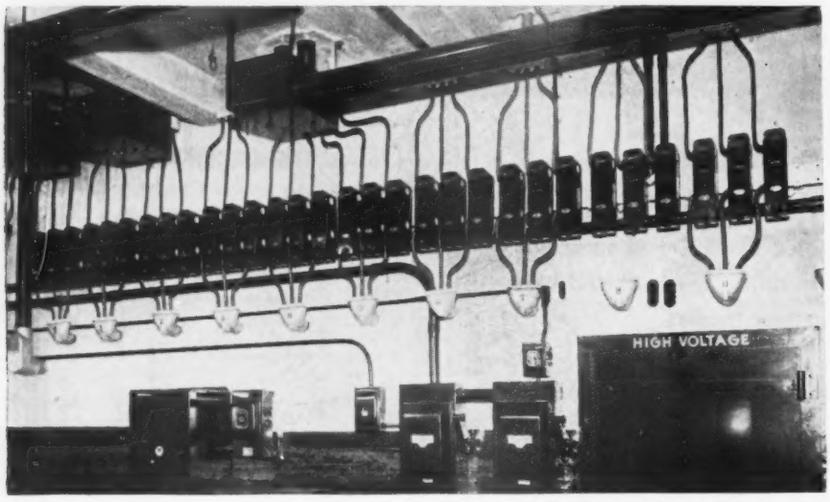
Among early considered possibilities were the use of disconnecting potheads and open switches. Potheads could have been mounted in the available space, but difficulty of operation, *i.e.*, the necessity of pulling the plugs by hand, and the problem of protecting the live ends when in the open position were major deterring factors. Open-type switches were ruled out due to the added cost and difficulty of providing barriers and special guards which would have been required.

Porcelain-housed switches possessed possibilities, but because of space limitations had not been considered up to this point. However, careful search yielded a switch in the desired 400-amp. size which was only $3\frac{1}{8}$ in. wide, and the space problem was solved.

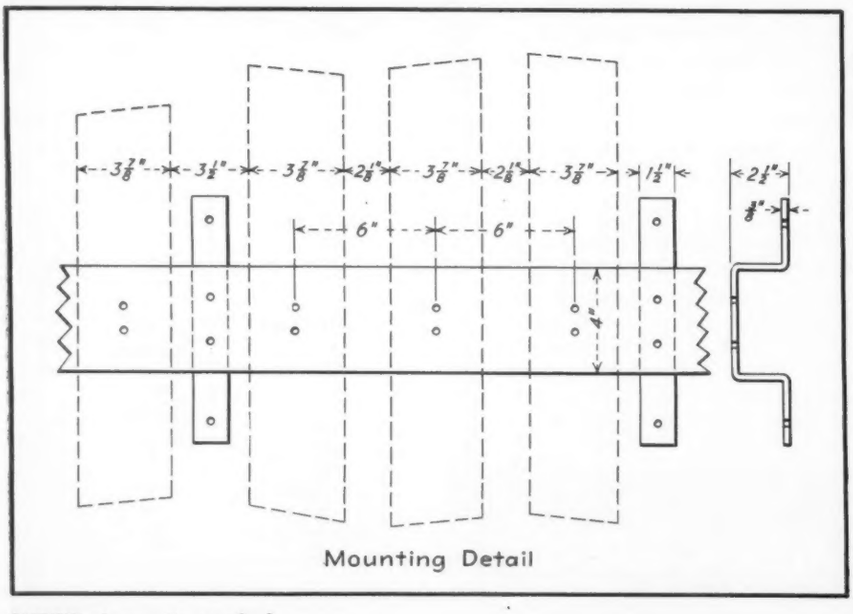
These porcelain-housed switches (W. N. Matthews No. 475) provided an independent unit in each phase of each circuit. Live parts would be completely inclosed with the switch in either open or closed position. They were capable of being operated with a conventional switch stick. These were all highly desirable features. Further, the per-unit-cost of porcelain-housed switches was comparable to other schemes. A considerable saving in installed cost was possible by reason of the relatively simple means required for mounting.

A $\frac{3}{16}$x4-in. flat strap supported on saddles made of $\frac{3}{8}$x$1\frac{1}{2}$-in. stock, providing $2\frac{1}{2}$-in. clearance between backs of switches and wall, was lead-anchored to the concrete wall. This $2\frac{1}{2}$-in. space provided wrench-room for bolting on the units and also to bridge over several low-voltage conduit lines already in place.

Switches were mounted in groups of three, spaced on 6-in. centers in each group, allowing $2\frac{1}{8}$ in. between adjacent units and $3\frac{1}{2}$ in. between groups. The over-all space occupied by the thirty units is 15 ft. $10\frac{3}{4}$ in., which leaves room for six more.



FIT THIRTY 400-amp. porcelain-housed disconnect switches into 19-ft. space with room to spare. Switches provide economical disconnecting means for ten 2,400-volt cable feeders



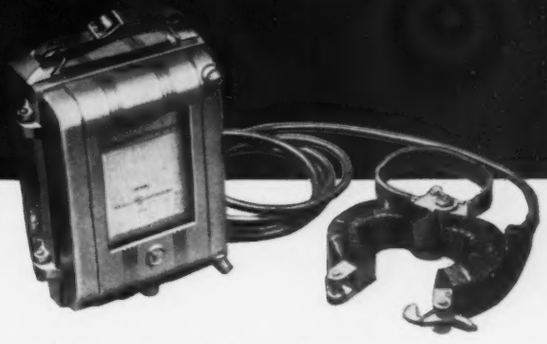
DETAIL of mounting method

Cost of Installing Mercury Lamps

Two 21,000-lumen mercury-vapor lighting units of 400 cp. each were recently placed in a public square by an Eastern power company at a total cost of $217.80. From the cost sheets of the company the following itemized outlays are given, for use in estimating such work elsewhere:

Liability insurance and payroll tax		1.80
Transportation expense		7.27
Materials:	(Total $166.58)	
No. 12 standard control cable, 4-conductor, 25 ft		2.50
Two fixtures and globes		58.48
Two street-lighting brackets		20.40
Two street-lighting transformers		66.06
Two 400-cp. mercury-vapor lamps		15.44
Miscellaneous hardware		3.70
Labor		$33.82
Stores expense		8.33
Total		$217.80

YOU GET BOTH *Accuracy and Convenience* with these HOOK-ONS



Inkless hook-on recorder for continuous current records. (Left) Extension pole for the hook-on volt-ammeter, available in 4- and 6-ft lengths

The speed with which this hook-on volt-ammeter can be used makes it ideal for load surveys. All you do is hook it around a conductor, flick the selector switch to "Amperes" and you have your measurement. The extension pole shown can be supplied for reaching into inaccessible places and for additional protection on high-voltage circuits.

Because it also measures voltage so easily, it is very handy for phasing-out secondaries in the banking of transformers and for determining the voltage balance in polyphase circuits. To measure voltage, connect the voltage leads, snap the switch to "Volts," and take the reading.

Then here's a hook-on instrument to *record* the duration of peak loads and the time at which they occur—without the necessity of cutting conductors or interrupting service. It consists of a Type CF-1 recording ammeter, and a split-core current transformer.

It's INKLESS—ready to go at a moment's notice—no inkwell to fill, no ink to spill, no pen to start.

It's easy to use—just close the jaws of the transformer around a conductor, connect the CF-1, and it starts to record.

For further information on the volt-ammeter, ask for Bulletin GEA-2950; on the recorder, GEA-3187. Your G-E office has copies, or write to General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

602-21-6200

INDUSTRIAL ENGINEERING

Switch Interlock for Motor Control Panel

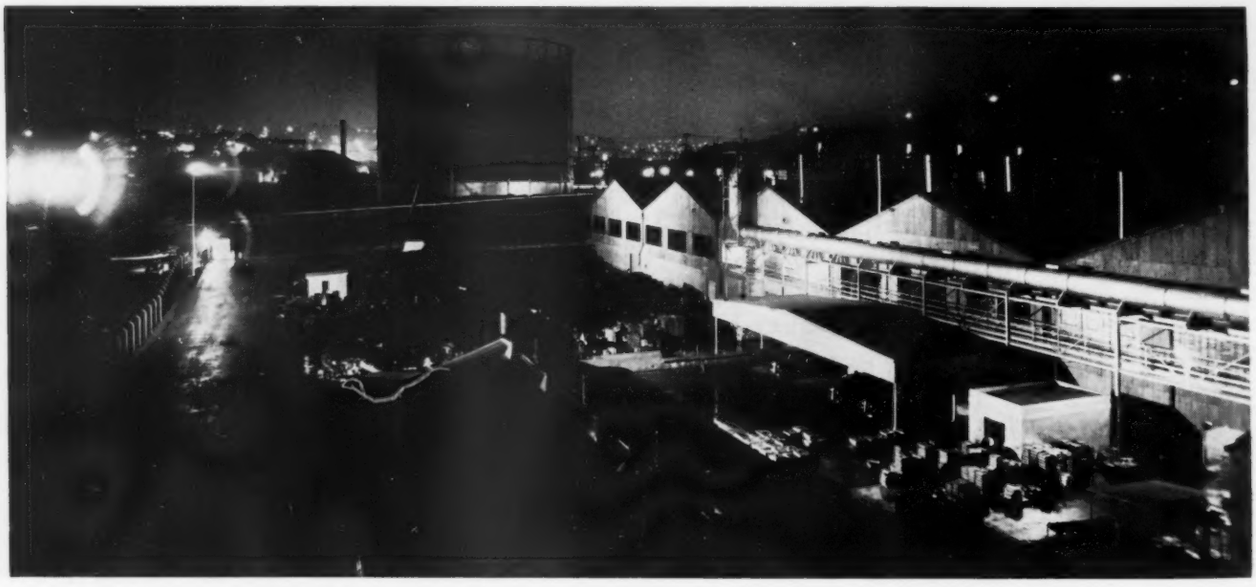
By EUSTACE C. SOARES
Consulting Engineer, New York City

Virtually all motor control panels used for controlling alternating-current motors of 100 hp. and over at 220, 440 or 550 volts are provided with a three-pole knife switch used as a disconnect or three single-pole disconnecting switches. But they lack a safety interlock feature, which can be added at very minor cost. The lack of this feature introduces a greater operating hazard than would appear to be the case at first blush. This can best be illustrated by taking a specific case, of several experienced, where a 175-hp., 440-volt, three-phase synchronous motor was installed in an industrial plant, replacing steam-driven equipment.

All the operators had many years of experience in the particular plant operation, but their electrical operating experience was limited to their steam-turbine-driven 100 kw. d.c. generating units which provided lighting and some auxiliary power. The operators had thus become accustomed through many years to take a generating unit off the line by opening an ordinary knife switch.

The control panel for the new 175-hp. synchronous motor was a nice piece of the switchboard builder's work. With line and field ammeters, push-button-operated magnetic contactor, automatic synchronizing relay and disconnecting switch, this control panel cost about $550. In this case the disconnecting switch was placed at the top of the panel in front. One operator wishing to shut down the synchronous motor for the first time neglected to use the "stop" push button provided, but through force of habit opened the disconnecting switch. Needless to say, the operator suffered first degree burns on his arm and almost ruined the knife switch. Yet had the switchboard been provided with an interlock on

Work Lighting Is Also Guard Lighting



PROTECTIVE and utilitarian lighting are combined at the new plant of the Federated Metals Division, American Smelting & Refining Company, San Francisco, Calif., where yards fronting on warehouses and foundries are floodlighted by Westinghouse type "CAK-16" floodlights with 1,000-watt Mazda lamps. These are mounted in groups on three poles 50 ft. above ground level. Two of the poles—one supporting four floodlights, the other five—may be seen at the left. Not shown is another pole on which is mounted four units. Floodlights may be operated singly or in groups; as an added safety measure, they also may be turned on and off by remote control from master switches located at several of the watchmen's stations in the plant.

THE NEW PLANT PUTS ADDED VALUE IN EVERY L-M TRANSFORMER

The new L-M plant at Zanesville was built with the express purpose of putting the utmost value in a transformer and still being able to offer it at a competitive price.

Here, the experience and manufacturing advances of the industry were incorporated . . . automatic line welders for tanks... infra-red drying ovens for paint... conveyor assembly lines . . . and a long list of other facilities that enable transformers to be made as you want them made.

Users tell us that they too can see in superior performance, how this new plant is putting added value in L-M Transformers.

This modern plant, coupled with the highest quality materials and workmanship gives you the best buy in transformers.

LINE MATERIAL COMPANY

the knife switch in series with the stop button any possible arc from opening the knife switch under load would have been suppressed through the interlock operating the magnetic contactor almost instantly.

Such an interlock can be purchased from any of the control manufacturers for $1.25, list, and the wiring of it is a simple and inexpensive job. The interlock may be wired either normally open or normally closed, so it can be adapted as a series switch, in series with the regular "stop" button, to trip the ordinary magnetic contactor, or as a circuit-closing switch to operate a separate trip coil. If such an interlock were installed by the manufacturer in the shop it would hardly add more than $3 or $4 to the shop cost of an item now selling for about $550.

• • •

Innovations in Spot Welder Supply

Power supply to the battery of spot welders at the "merry-go-round" where the top panels of Nash automobile bodies are fabricated at the Seaman body division of Nash-Kelvinator Corporation, Milwaukee, can perhaps be taken as typical of the electrical system methods and welding technique throughout this plant, where spot welding is the principal fastening method in use. At least this sub-assembly line can be used to bring out the departures from conventional welding practices in use at this plant.

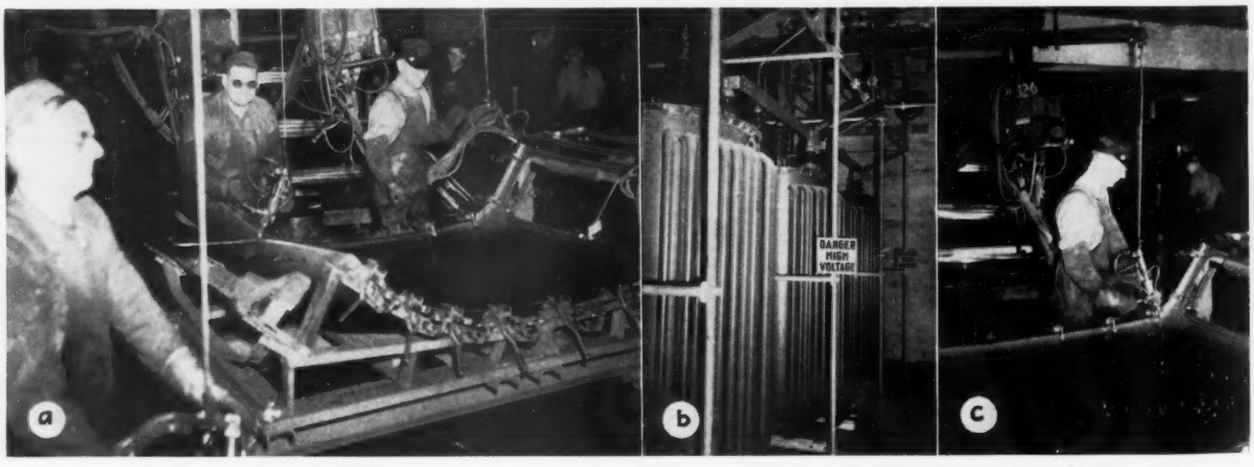
Nine portable semi-automatic spot welding guns, each capable of making 275 spot welds per minute on 20 gage sheet steel, are used on the merry-go-round, a fact that contributes substantially to the production rate of 50 panels per hour from this department. Each of the nine guns is supplied from a 50-kva., 440/12-volt transformer which draws a momentary welding current of approximately 275 amp. from the supply line during the 2–2½ cycle welding time. This corresponds to a duty cycle of about 4 per cent, which is the average for the rest of the plant. Weld time in other parts of the plant ranges from a minimum of 1 to a maximum of 4 cycles, with the average weld duration for all operations 2½ cycles. Welding pressure on guns is 450 lb. average.

Three short feeder circuits of No. 4/0 copper which tap risers from a 500-kva., 13,200/480 volt, delta-connected transformer bank located on the floor above, serve the nine welders on the merry-go-round. Each circuit is fused for 200 amp. and serves three of the nine 50-kva. spot welding transformers. Welding transformers are themselves fused at 100 amp.

Maximum voltage drop from the secondary of any main transformer bank to the most remote spot welder is estimated to be approximately 10.5 per cent. Thus, with 480 volts at the main transformer secondary busbars, supply voltage at the welding transformer would be of the order of 430 volts.

No trouble with voltage flicker is encountered at this plant, perhaps for the reason that load on the several main transformer banks supplying the plant's welding operations is carefully balanced and is practically constant due to the diversifying effect of a very large number of welders in intermittent operation. Beside the 500-kva., three-phase transformer bank already mentioned, welding operations are also supplied from a 1,250-kva., 13,200/480-volt low-impedance transformer bank.

Two 100-amp. contactors are used for each welder and are actuated by a pressure relay connected in the compressed air system to each welder cylinder. Each of the two 100-amp. contactors is in a separate leg of the 440-volt primary supply line to the welding transformer. Dan Eyster, welding engineer, reports that use of two contactors instead of one, as is more usual, cuts down the amount of contact burning, since there is twice the contact area involved in breaking the arc, and the current density per unit of contact area is accordingly less. This system also avoids accidents. Contactors of this size are unusually large for this duty, but are believed necessary in order to pass the heavy momentary currents involved, without sticking or burning. It is claimed that with two 100-amp. contacts in the welding transformer circuit momentary currents as high as 350 amp. can be successfully interrupted without excessive burning.



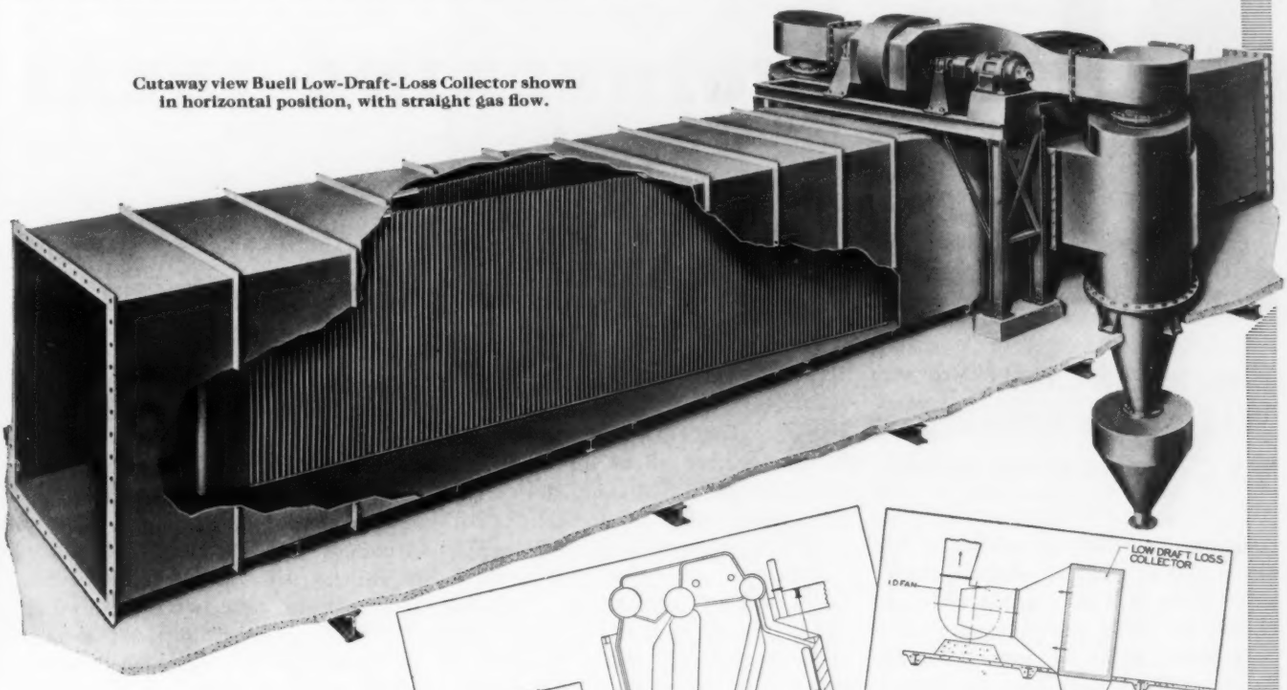
FACILITATORS of automobile production welding

(a) Jig holding auto-body top on its way past part of the nine spot-welding guns on merry-go-round type of assembly line.

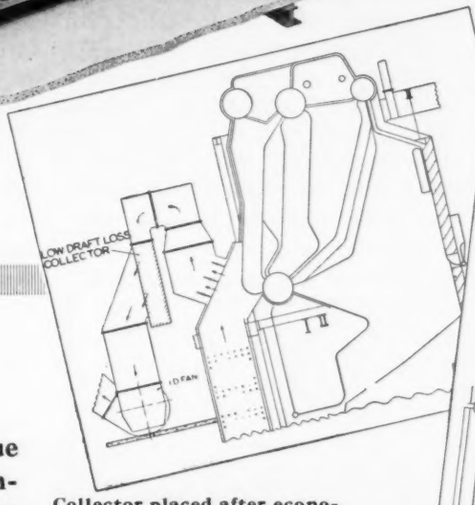
(b) Three-phase, 500-kva., transformer bank steps 13,200 volts down to 480 volts for welding transformers. Merry-go-round welders are only part of welding load supplied by this bank. Several similar banks serve welding load in other parts of this plant.

(c) Welding drip molding on auto-body top. Guns like this one are capable of making 275 welds per minute in 20 gage metal in 2-2½ cycles, drawing 275 amp. momentarily in 440-volt primary of 50-kva. welding transformer.

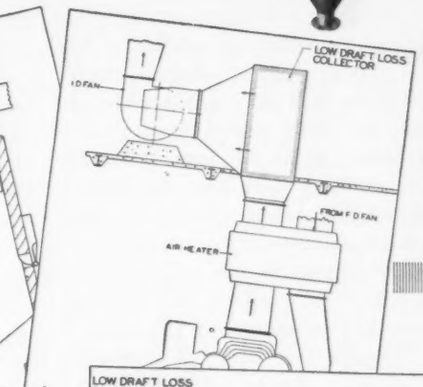
INSTALLED AHEAD OF THE INDUCED DRAFT FAN ON STOKER-FIRED BOILERS



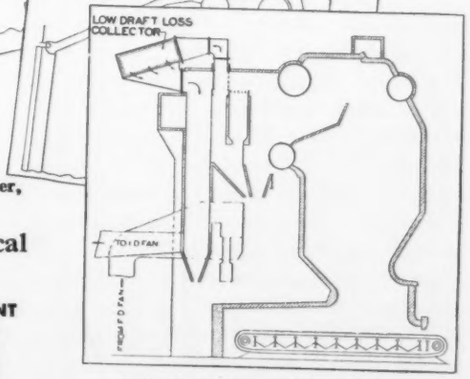
Cutaway view Buell Low-Draft-Loss Collector shown in horizontal position, with straight gas flow.



Collector placed after economizer, vertical, with down flow.



Collector placed after air heater, vertical, with up flow.



Collector between boiler and economizer, set at angle to clear roof trusses.

4 *Easy Installation*

The Buell LOW-DRAFT-LOSS Flue Dust Collector is extremely compact and can be installed in any position—vertical, horizontal, or at an angle—to fit into existing ducts. On new jobs, flues can be arranged to accomodate the collector without appreciable change in plant layout. The illustration of the collector above, and the drawings herewith, show several possible arrangements.

5 *High Collection Efficiency*

The specially designed Buell (van Tongeren) LOW-DRAFT-LOSS Flue Dust Collector attains a high overall efficiency on flue dust from stoker-fired boilers, of which the following is a typical size analysis:

MICRON SIZE	PER CENT
0-20 microns	5%
20-30 microns	5%
30-40 microns	15%
40-70 microns	25%
70 microns and larger	50%

Additional efficiency is attained by installing the Buell LOW-DRAFT-LOSS Collector in front of the induced draft fan where the dust particle sizes are larger and more easily collected.

Write for complete description of the Buell (van Tongeren) LOW-DRAFT-LOSS Flue Dust Collector, with a report of its operation in the plant of one of the country's greatest public utilities.

BUELL ENGINEERING COMPANY, Inc.

Suite 5000, 75 Pearl Street, New York

Nation-wide service through offices of either Buell Engineering Co. or B. F. Sturtevant Co.

NEW ENGINEERING IDEAS

Reactance Chart for Welder Bus Problems

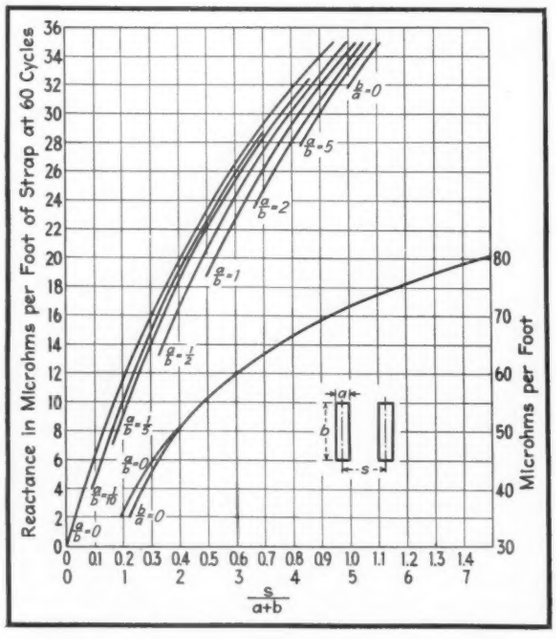
By R. C. BOUSE and J. D. SCARBROUGH
Detroit Edison Company

Group installations of large resistance type welders, such as flash, projection, spot and multi-speed machines, generally receive their power over some form of low reactance bus or cable system. With low power factor machines of one to several thousand amperes input (at either 220 or 440 volts) becoming increasingly common, it is obvious that the reactances of the plant supply must be kept low if reasonably good voltage regulation is to be maintained.

By means of the following short-cut method, utilizing charts of reactance for a pair of conductors (either for single conductors or strand cables), it is possible to calculate the reactance of an interlaced bus or cable system with a reasonable degree of accuracy in a few minutes, as compared with the more laborious method based upon the fundamental relations of mutual and self-inductance, which at best requires several hours.

The basic method and curves used are contained in scientific paper No. 281 by Francis B. Silsbee and in the *Electric Journal* of June, 1919, in an article entitled "Reactance Values for Rectangular Conductors," by H. B. Dwight. The following treatment brings together all of the necessary data for the calculation of welder bus reactance and for the calculation of interlaced conductors.

The three general types of welder buses which are commonly used are, (1) interlaced copper bars, (2) four or more stranded insulated conductors interlaced and clamped together, and (3) concentric tubes. Curves showing total reactance (self minus mutual) between two conductors may be used in the following manner when more than two conductors are involved and there is an even number of conductors:



REACTANCE of strap conductors at 60 cycles. For total circuit reactance (going + return) multiply by two

Consider an interlaced bus consisting of six conductors, three going and three return, arranged in the following order: 1+, 4—, 2+, 5—, 3+ and 6—. Since the average drop of the going circuit (1, 2, 3) equals the average drop of the return circuit (4, 5, 6) it is only necessary to find the drop in the going circuit and multiply it by two to determine the total circuit drop. If as a first approximation it is assumed that the current divides evenly between all of the going conductors, the reactance of any going conductor is the sum of the reactances of all the return conductors to the given going conductor minus the reactance of the remaining two going conductors to the given going conductor. Dividing the sum of the reactances of the going conductors by three gives the average going reactance per conductor and dividing this average by three (since it is assumed that only one-third of the current went through each conductor) gives the going circuit reactance.

Multiplying this value by two gives the total circuit (going plus return) reactance.

The reactance of each going conductor can be written as follows:

$$X_1 = X_{14} + X_{15} + X_{16} - X_{12} - X_{13}$$
$$X_2 = X_{24} + X_{25} + X_{26} - X_{21} - X_{23}$$
$$X_3 = X_{34} + X_{35} + X_{36} - X_{31} - X_{32}$$

The total circuit reactance (going plus return) is

$$X_T = \frac{2}{9}(X_1 - X_2 - X_3)$$

This method is accurate within 10 per cent, which is good enough for most practical calculations.

Numerical Example—Determine the reactance of an interlaced bus, 1,000 ft. long, consisting of ¼ x 4-in. copper bar spaced 1 in. center to center in sequence mentioned in the fifth paragraph. The distance between the centerline of each

conductor and all of the other conductors should be calculated and the reactances corresponding to these distances should be obtained from the graph.

For example, the distance between the centerlines of conductors 1 and 4 is 1 in.

$$\frac{S}{a+b} = \frac{1 \text{ in.}}{\frac{1}{4} \text{ in.} + 4 \text{ in.}} = 0.235$$ and the corresponding reactance is 0.0125 ohm per 1,000 ft. The remaining reactances can be found in a similar manner.

$X_1 = 0.0125 + 0.0290 + 0.0392 - 0.0220 - 0.0347 = 0.0240$

$X_2 = 0.0125 + 0.0125 + 0.0290 - 0.0220 - 0.0220 = 0.0100$

$X_3 = 0.0290 + 0.0125 + 0.0125 - 0.0347 - 0.0125 = -0.0027$

$X_T = \frac{2}{9}(X_1 + X_2 + X_3) = \frac{2}{9}(0.0249 + 0.0100 + 0.0027) = 0.00696$ ohm (going and return)

Cases 2 and 3, with examples showing the solution of the reactance of stranded cables and of concentric tubular buses, will be given in a future article.

•

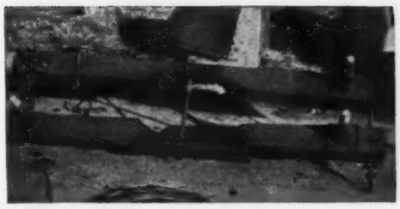
Leakage Currents May Be Cause of Pole Fires

By C. C. CORNELIUS
Superintendent Overhead System Kansas City Power & Light Company, Kansas City, Mo.

Investigation of the possible causes underlying an epidemic of pole top burnoffs on double-circuit wood-pole sub-transmission lines of the Kansas City Power & Light Company has brought to light some interesting conclusions pointing to a probable electrical cause for the phenomena and indicating possible solutions.

On 14 miles of 33-kv. two-circuit line (delta system grounded at substation through reactor), where conductors of each circuit were arranged vertically under each other on outer ends of three crossarms with corresponding phases of the two circuits on the same arm, seventeen pole top burnoffs have occurred since 1931; fifteen of these have occurred just below the middle arm and two have occurred below the lower or third arm. On 54 miles of single-circuit lines with two-arm construction, where two phases are carried on the top arm and one phase on an arm below, five burnoffs have occurred since 1931, with burnoffs occurring at the pole brace attachment on the lower arm.

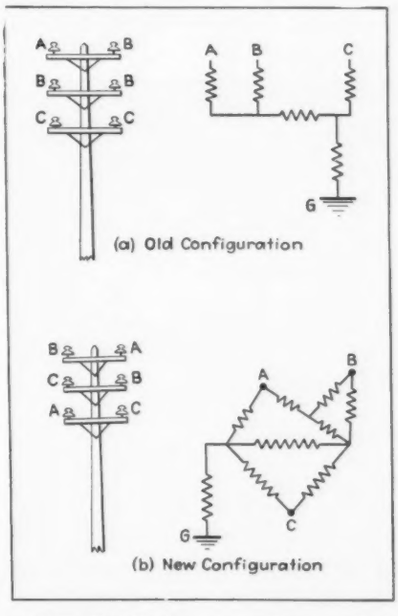
Burnoffs were usually preceded by a long dry spell when the pole was extremely dry and when considerable dust and soot had accumulated. Firing occurred after a misty rain when the moisture was just sufficient to wet the surface of the poles.



PORTIONS of burned off poles

Theory advanced as to the cause of the burnoffs is that the moist pole surface offers a path for line leakage currents which tend to concentrate at the point where the brace of the arm is attached to the pole or at the crossarm through bolt. Existence of a loose bond between hardware and pole at these points under certain conditions introduces sufficient resistance in the leakage current path to cause local heating or arcing and start a fire in the tinder dry surface wood of the pole. In the company's laboratory a fire has been started in the dry subsurface wood of wet poles with currents of 10 m.a. consistently, with 5 to 6 m.a. under ideal conditions.

Referring to the accompanying sketch, the impedance diagram can be set up. Using values of wet wood resistance, determined in the laboratory, calculations indicate a leakage current concentration of 10 to 15 m.a. where the middle crossarm braces attach to the pole. Calculations also show between 5 and 10 m.a. at the top crossarm brace and about 10 m.a. at the bottom crossarm through-bolt.



CONCENTRATION of surface leakage currents at bond between X-arm brace and pole may indicate electrical cause of pole fires.

(a) Pole top arrangement for old configuration

(b) New pole top configuration intended to reduce concentration in hardware.

Methods for Relief

Three methods for relieving the conditions are suggested by the above: (1) Crossarm braces and through-bolts of all arms could be bonded together to lessen leakage current concentration at the pole. (This is not so desirable as it would remove the insulation of the wood of the pole and increase the possibility of three-phase shorts.) (2) Metal braces could be replaced by wood braces. (Probably the best solution, but expensive.) (3) Improvement may possibly be had by rearranging phases so that like phases will not exist on any one arm.

With this configuration, calculations indicate leakage currents (at the points mentioned) are approximately half the value for the middle arm brace previously found. However, there now exists a leakage current across each arm between unlike phases that did not exist before and which is indicated to be as large as or larger than the leakage value at the middle crossarm brace on the old configuration. It is believed, however, that the increased leakage across the arm will not cause firing, as fir is not so susceptible as cedar, and since the possible concentration points are at the bases of pins where more contact area is available. Operation of 29 miles of line where all phases are on the same crossarm and where the phase spacing is no greater has caused no firing on fir crossarms.

LOAD BUILDING

Dramatic Lighting for Jewelry Store

By H. H. CARPENTER
Blackstone Valley Gas & Electric Company, Woonsocket, R. I.

When a small store proprietor relights his store he is interested in several things: First, he wants to spend as little money as possible and still do a good job. Second, he wants to illuminate his merchandise to the best advantage. Next, he wants to attract customers into his store from the street by presenting a well-lighted, pleasing appearance.

With these thoughts in mind equipment by Holophone Company, Inc., and Day-Brite Lighting, Inc., was chosen for a Woonsocket jewelry store. The original 14-ft. ceiling was dropped 3 ft. and the units semi-recessed. The lowered ceiling resulted in more foot-candles per watt (top of counters 39 to 40 ft.-candles) and allowed much of the heat to be trapped above the false ceiling. Extra light of 60 ft.-candles was provided on the rear counter to draw the people deeper into the store. It was definitely proved that prismatic glass provides the best light for the display of diamonds and produced interesting highlights on jewelry. The wall case lighting, consisting of reflector flood lamps, was extremely successful, penetrating well to the lower shelves.

The picture clearly demonstrates the importance of using light backgrounds as the same amount of light gives twice the effect in a white case as in a dark colored case. A recessed night light illuminates the safe for protection and allows the clock to be read through the front door of the store. It has been found that many people on the street late at night peer into the store to determine the time. The light colored floor and the lighted lamps on display produce a well-lighted ceiling and result in very little contrast between the luminaires and ceiling.

THREE 150-watt reflector floods dramatize glassware display and light penetrates all shelves. Light-colored backgrounds are an added help in this case

•

Appliance Show Aids Load Building

Substantial proof of the load building effectiveness of carefully organized appliance expositions for cooperating dealers comes from South Bend, Ind., where the Indiana & Michigan Electric Company and some 47 dealers and distributors staged a six-day appliance "show," organized on a "share-the-cost basis." This activity, which drew an attendance of 18,000, consisting largely of family groups, resulted in the sale of 215 appliances valued at $30,457.85. Breakdown of appliances sold is given in the following table:

No. Sold	Appliance	No. Sold	Appliance
25	Ranges	27	Sweepers
2	Water heaters	1	Stoker
115	Refrigerators	3	Water softeners
14	Washing machines	8	Miscellaneous
5	Oil burners		
15	Radios	215 = $30,457.85	

In planning the exhibition a studied attempt was made to attract family groups and to limit attendance at each session to numbers that would allow dealers to concentrate their selling efforts. To do this dealer premiums that might have attracted

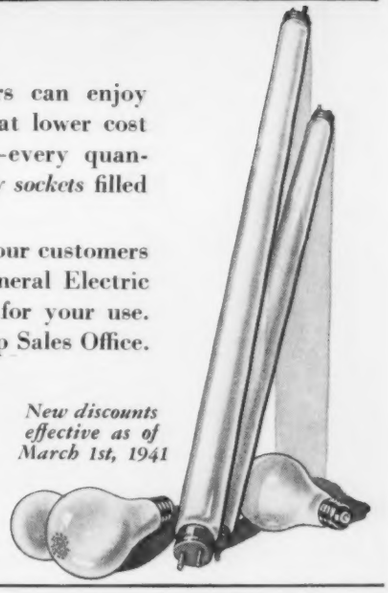
General Electric Announces Lower Prices on Quantity Purchases of G-E MAZDA Lamps!

EMPTY sockets will be filled with right size G-E MAZDA lamps in thousands of factories, offices, stores, apartments, yes and in many homes, too—as these new, larger discounts are publicized through G-E advertising in magazines and on the air!

Now the small factory, office, shop, restaurant can buy the lamps they *prefer* at generous discounts even on purchases as low as $5.00!

It means that your customers can enjoy Better Light for Better Sight at lower cost than ever before. Remember—every quantity purchase means *more empty sockets* filled with right size lamps!

Because you will want to tell your customers about these new discounts, General Electric has newspaper mats available for your use. See local General Electric Lamp Sales Office.



G-E MAZDA LAMPS

GENERAL ELECTRIC

New discounts effective as of March 1st, 1941

NEW! **65-WATT G-E MAZDA F (FLUORESCENT) LAMP** available April 1st. Of special interest to stores, hotels, restaurants, clubs, offices! Colors: Daylight and 3500° White. Size: 36″ length, 2⅛″ diameter. List price $2.75.

NEVER STAB a POLE in the BACK

• Deep stab holes have shortened the life of many costly poles by providing a place where moisture accumulates and rot starts.

Use the new MULTIPOINT CANT HOOK. Its six ¼" points hold more securely than a single long point—yet leave no deep, dangerous holes—in fact, they do not penetrate through the creosote treatment. Here is an easy and inexpensive way to eliminate injurious holes. Further, the new Multipoint Cant Hook gives greatly increased efficiency in pole handling—it grips more securely—spreads the strain over larger area—and more than that, it's self-releasing.

Safer and more efficient to use—will not injure costly poles. Made by The American Fork & Hoe Co., Cleveland, O.

STURDETOOLS
a **TRUE TEMPER** **PRODUCT**

STURDETOOLS
MULTIPOINT CANT HOOK
6 points ¼"x½" in size grip the pole securely but leave no deep hole to encourage rot and decay.
Furnished in small, medium and large sizes for handling poles up to 22" in diameter. Prices and complete description on request.

Distributed by
JOSLYN MFG. AND SUPPLY CO.
Executive Offices
20 North Wacker Drive • Chicago, Illinois
Branches and Warehouses with Complete Stocks in Principal Cities of the United States

ORGANIZE co-operative appliance exposition to attract family-group prospects in easily handled numbers

large acquisitive crowds with a low buyer content were barred. To attract family groups the show was kept open six evenings of its six-day run. Length of the run also acted to limit attendance at individual sessions and permit concentration of selling effort on recognized prospects. The presence of factory representatives in the booths of distributors gave dealers an opportunity to call on them for assistance in closing deals that were in suspense.

Dealers' booths averaging 16 x 12-14 ft. were arranged around the outstide of the 241 x 129-ft. display floor, with distributors' booths 60 x 18-20 in the center manned by manufacturers and distributors' representatives. Dealers' space was sold for approximately $30 to cover expense of the show. Dealers drew lots for location. The local electric league took charge of the actual operation and policing of the exposition.

A prize award scheme, in which only purchasers were eligible, permitted a close check of amount, type and number of appliance sales.

•

Sells Fluorescent—Holds Wattage

By **PAUL CHANDLER**
Boston Edison Company

Cooler foot-candles were requested; more and cooler foot-candles were delivered by the installation of

PREVIOUS WATTAGE RETAINED in new installation using fluorescents

troops ... Hainan and Formose islands.

strike ... 850-mile

General Electric Announces New 65-watt MAZDA F lamp!

AVAILABLE APRIL 1ST

COLORS—3500° white, and daylight

SIZE—36″ long, 2⅛″ in diameter

PRICE—List price is $2.75

This new 65-watt MAZDA F (fluorescent) lamp helps complete General Electric's line of G-E MAZDA F lamps. It offers new lighting opportunities for stores, shops, hotels, restaurants, clubs, offices, and other commercial establishments who will be glad to get the benefit of these cool tubes of indoor daylight. Inquire about Certified Fleur-O-Lier fixtures for this new lamp. Be sure you order G-E MAZDA lamps *—made to stay brighter longer.*

G-E MAZDA LAMPS

GENERAL ELECTRIC

You can put a STATES STROBO-METER on your test tables!

MASTER STROBO-METER

Registration Indicator

• Two to four times increased production —elimination of personal errors — two excellent reasons why the States Master STROBO-Meter should be on *your* test tables. Your testers will find it easier to obtain more uniformly accurate results—and at the same time reduce your testing costs. It'll pay you to investigate the "STROBO" and "Timed Control" methods of test. *For a complete description, send for Bulletin No.* 309.

Timed Rev. Control Unit

Testing with STROBO Light Adjust meter with disc in motion

THE STATES COMPANY 3 New Park Ave. Hartford, Conn.

Hygrade "Miralumes" at the Federal Savings & Loan Association, Natick, Mass. Under the old system of incandescent lamps the indoor temperature ran 10 degrees higher than the outdoor and required abnormal operation of the air-conditioning system to maintain comfortable conditions. The Edison company met this situation with a proposal to replace the incandescent with 200-watt fluorescent fixtures, which not only reduced the heating effect somewhat, but raised the illumination level from 10 to 30 ft.-candles. Psychologically the coolness of the new system is very effective. Both old and new lighting systems were of the semi-indirect type. The old system, however, consisted of dense leaded-glass bowls with four 50-watt lamps per fixture. No reflectors were employed.

Desk and counter lamps were eliminated in the change, but the watts per sq.ft. from the overhead lighting remained the same. Eight fixtures were involved in an area 45.5 ft. long x 23 ft. wide, with a 13-ft. ceiling height. The walls are cream with a white dado extending 3 ft. 4 in. from the floor. The floor is of composition black and white tiles, each 12 in. square. No change was made in the interior other than in the overhead lighting system. The cost of the fixtures was $55 each and the cost of hanging them about $25. The bank is well pleased with the result, which accomplished far more than it had anticipated. From the utility's viewpoint, it represents the kind of fluorescent lighting that can be heartily indorsed.

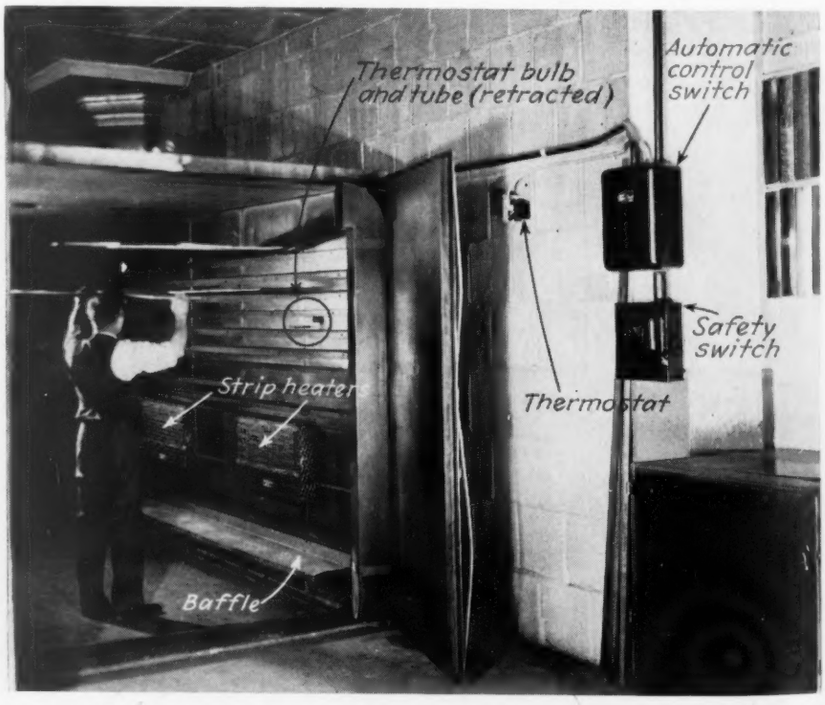
•

Electric Heaters for Gas-Fired Oven

By L. W. MAKLEY
Power Sales Department, Dayton Power & Light Company, Dayton, Ohio

It isn't often that two types of heat are found in the same oven! But in the Dayton, Ohio, laboratory of Oxford Varnish Company there is such an oven, and there were some good and sufficient reasons for this peculiar arrangement when the installation was made.

This company frequently checks in the laboratory some of the production methods proposed by its clients for simulating wood grain finishes on furniture and metal products. A gas-fired oven was used for baking varnished and painted finishes in most such check runs. However, the inflexibility of the oven, its extreme temperatures, the discoloration of certain specimens, coupled with the need for drying particular samples under controlled humidity at fairly low temperatures, led to installation of 10-kw. of electric



TEN KILOWATTS of electric strip heaters added to gas-fired oven extends its range of usefulness for baking simulated wood finishes on metal products and furniture. Oven uses 7 kw.-hr. per hour

BUY BULBS
that stay brighter longer
..that are the right size
Get rid of Bulbsnatching with Right Size Bulbs
AVOID EYESTRAIN
throw out wrong size Lamp Bulbs
House Cleaning Time is Sight Saving Time with Right Size Bulbs
FORWARD
to Better Light-Better Sight
MARCH
is Right Size Lamp Month
G-E MAZDA LAMP PRICES begin at 10¢

How 7,000,000 lamp bulb purchasers can put SPRING IN THEIR EYES!

• In too many homes, neglect or bulb-snatching has put the wrong-size lamp bulb in important seeing sockets . . . places where youngsters study, where older people read and sew. Eyestrain is serious. Right size lamp bulbs cost little to buy—little to use, so why encourage trouble? Protect your family's eyesight and bring Spring freshness to their seeing by making sure that every socket is filled with the right-size G-E MAZDA lamp bulb.

How to tell a wrong size lamp bulb

We suggest this simple guide: in reading lamps your G-E MAZDA lamp bulbs should total at least 100 watts, properly shaded; for sewing or mending, you need about three times as much. Better still, drop in and ask your lamp dealer to help you choose the right size G-E MAZDA lamps.

Study is easier . . . when I.E.S. lamps have at least a 100-watt 15¢
Cheer up your kitchen and lighten tasks with a 150-watt 20¢
Have pleasing indirect light with 150-watt Silvered Bowl 45¢
Enjoy reading more, with a 3-lite, 100-200-300-watt . . . 60¢

G-E MAZDA* LAMPS

GENERAL ELECTRIC

*MAZDA—not the name of a thing but the mark of a research service

85,000 DEALERS will get this G-E tie-in display for RIGHT-SIZE LAMP MONTH

G-E MAZDA LAMPS
GENERAL ELECTRIC
AS SEEN IN
THE SATURDAY EVENING POST
STOCK UP AT THESE LOW PRICES
BE SURE TO BUY THE Right Size

THIS AD WILL FILL MILLIONS OF EMPTY SOCKETS THIS MONTH!

THIS POWERFUL four-color ad appears in March 1st Saturday Evening Post. Here's an activity built to order for you. Thousands will see this compelling four-color right lamp message in the March 1st Saturday Evening Post and March 2nd American Weekly. Thousands more will see reprints of this ad in dealer's windows and on dealer's counters.

AND HERE'S WHAT YOU CAN DO ABOUT IT

1. Feature Right Size Lamps in your own lamp displays.
2. Urge dealers to use Right Lamp display material.
3. Tie up with Right Lamp advertising in local papers. Newspaper mats available.

RUBBER COVERED POWER CABLES • BUILDING WIRE

CRESFLEX NON-METALLIC SHEATHED CABLE • SERVICE ENTRANCE CABLE • MAGNET WIRE • BARE WIRE

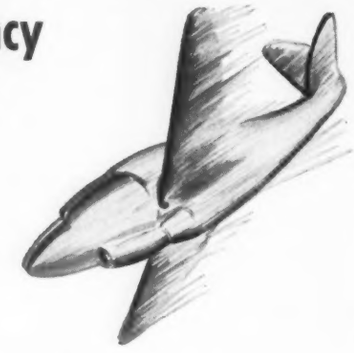
ARMORED CABLE • FLEXIBLE CORDS • LEAD ENCASED AND PARKWAY CABLES • VARNISHED CAMBRIC

CRESCENT

meets the emergency which demands

MORE SPEED—
MORE POWER
for

DEFENSE



CRESCENT has been working night and day, meeting defense needs as well as keeping up with the demands of normal business. Every man is at his post—putting his utmost efforts into producing the finest wire and cable we know of — helped by over 50 years of knowing how.

RUBBER POWER CABLES
SIGNAL CABLES
CONTROL CABLES
VARNISHED CAMBRIC CABLES
PORTABLE CABLES
PARKWAY CABLES
BUILDING WIRES and CABLES

CRESCENT INSULATED WIRE & CABLE CO.

CRESCENT
WIRE and CABLE

Factory: TRENTON, N. J.—*Stocks in Principal Cities*

CRESCENT ENDURITE SUPER - AGING INSULATION

strip-type heating units. This gave the laboratory the operation it desired and still permitted use of gas when needed for other operations.

The oven to be heated was about 6 ft. wide, 12 ft. long and 6 ft. high. To dry enamels and paints on wood and metal it was desirable to maintain temperatures of from 100 to 200 deg. Strip heaters of 10 kw. capacity were necessary to secure this temperature. But before installation it was important to shield the elements so that when gas was used in other operations the flame from the open burner would not contact the elements and destroy them. This was done, as shown in the accompanying illustration, by installing a sheet-metal baffle above the gas burner to deflect the flame. Elements were positioned above the baffle at a point on the wall near the floor. The load was balanced on the three-phase, 220-volt, three-wire circuit.

Thermostats Spotted

Proper placing of the thermostats inside the oven required some care to get it near the specimens, but not too close to the heaters themselves or in a remote corner that might contain stagnant air at a great variance with that near the work. To bring the thermostat element near the work it was finally decided to bore a hole through the oven wall near the door and project the element into the oven interior through a retractable metal tube. Thus, both the thermostat element and tube can be withdrawn from the oven after each bake and the hole plugged by a metal cap which remains in place during periods when the oven is operated with gas.

In operation the oven is loaded with specimens in the afternoon at closing time and operated from 5 p.m. to 11 p.m. and the thermostat set to maintain a temperature of 100 to 120 deg., depending on the type of work. Once the thermostat is set constant vigilance on the part of the oven tender is unnecessary. The oven uses approximately 7 kw.-hr. per hour.

Of particular interest is the fact that work done in the laboratory with the electric oven can be exactly duplicated on a production basis by manufacturers in their own plants. The recommendations of the laboratory, therefore, are particularly enthusiastic in commendation of electric heat.

A New Source For Increased Revenue

By T. E. FAJEN
General Manager, Electrical Division, National Enameling and Stamping Company

IS YOUR company today faced with the need for increased revenue . . . without a large capital investment in generating and distribution equipment? Do you have a high percentage of unprofitable low-use customers? Are you looking for expanded daylight load? Is an appliance that uses 700 K.W.H. annually, at lighting rates, of interest?

To meet such needs we have developed the NESCO CHEF . . . an entirely new appliance. It is a complete electric cooking device, attractive in appearance, with surface cooking and broiling facilities, a full size roaster-oven, and generous storage space.

- ★ **It operates on 110-120 volt service.**
- ★ **It requires no installation expense.**
- ★ **It adds twenty-five dollars annually in new revenue.***
- ★ **It affords complete electric cooking.**
- ★ **It prepares three average family meals daily.**
- ★ **It is applicable to any type of home.**
- ★ **It is smart in appearance — practical in operation.**
- ★ **It is as easy to own as a radio.**
- ★ **It is readily merchandised by dealers.**

(*From an analysis made by a leading utility. Further information on request.)

The NESCO CHEF will meet a need of the great mass of lower income families who cannot afford to own and install an electric range. It appeals to pride of ownership, and answers the demand for complete electric cooking created by intensive promotion of the electrical industry.

A full eighteen quart roaster-oven provides ample facilities for baking, roasting, canning, and all other oven functions. Preparation of complete oven meals is provided for with the cooking utensil set and adjustable rack.

The surface and broiler unit with 600, 1200, and 1600 watt combinations adequately fills the demand for surface cooking and broiling purposes. A heavy cast aluminum grid plate affords an ideal frying and grilling surface for average family requirements.

A convenient broiler compartment, with a porcelain enameled liner and hinged door, supplies ample room for any broiling requirement. It also serves as a warming compartment for left-overs, keeping prepared foods warm, heating dishes.

The top is finished in porcelain enamel, as are the broiler compartment door and switch panel. Regular range-type handles are used, and smartly designed range-type switches set the NESCO CHEF off as an attractive, modern appliance. Other parts of the body are finished in high-lustre baked-on enamel, and the whole mounted on a heavy electro-welded all-steel frame.

Generous storage space for other electrical and kitchen appliances is provided below the roaster-oven and broiler compartment. A timer clock, built into one of the storage compartment doors, is available as an accessory, thus making the NESCO CHEF completely automatic.

Here then, is the answer to a definite problem — a vital link to increased revenue.

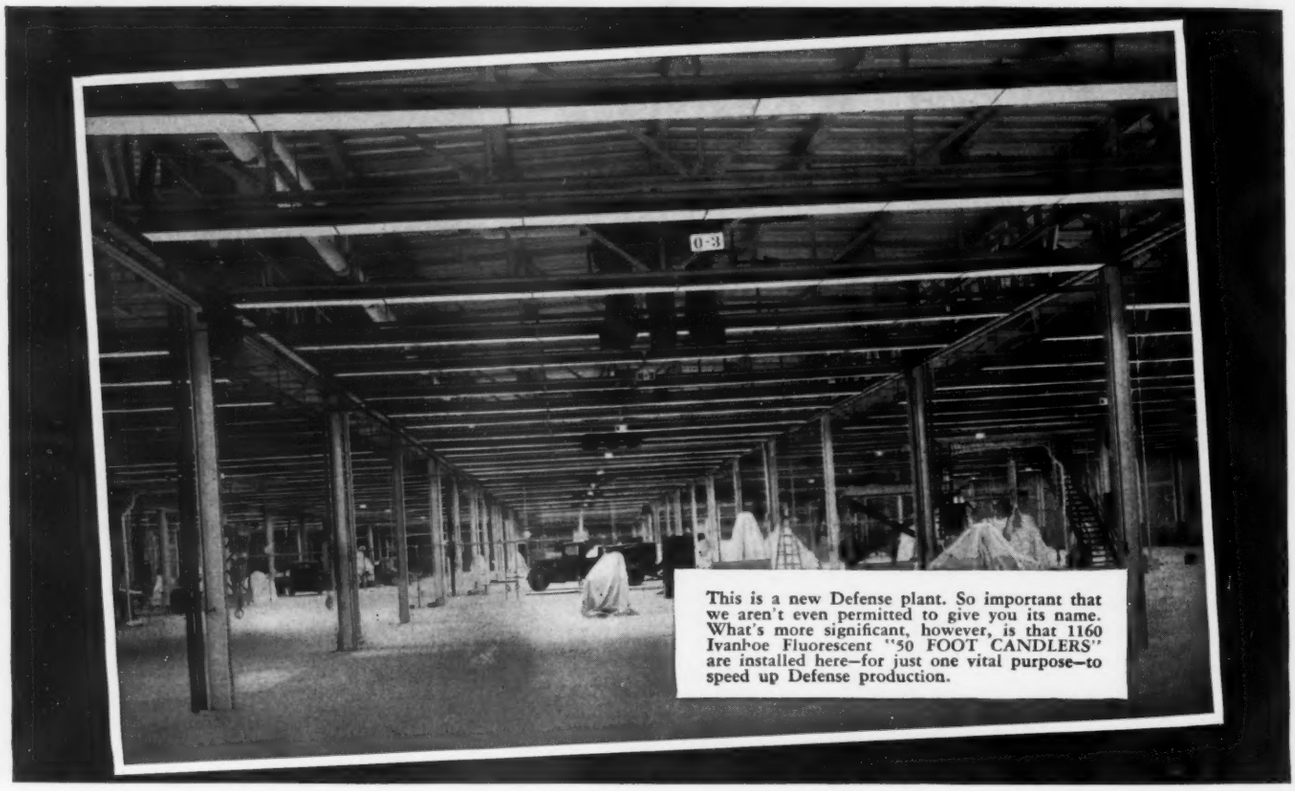
- ★ **Requires no additional expense in distribution systems and transformer equipment.**
- ★ **Replaces other types of cooking fuel. Stabilizes monthly revenues with daily use.**
- ★ **Does not require additional plant capacities — offers new domestic daylight load.**
- ★ **Operating current is sold in the higher rate brackets.**
- ★ **Increased revenue, without added capital investment, is immediately realized.**

If you have not received a brochure completely illustrating and describing the NESCO CHEF, a copy may be secured on request. We suggest you have one of our representatives call in person to discuss merchandising possibilities.

ELECTRICAL DIVISION . . . NATIONAL ENAMELING AND STAMPING COMPANY
293 N. 12TH STREET, MILWAUKEE, WIS.

Advertisement

More than a Mile of IVANHOE FLUORESCENT "50 FOOT CANDLERS" work here for National Defense!



This is a new Defense plant. So important that we aren't even permitted to give you its name. What's more significant, however, is that 1160 Ivanhoe Fluorescent "50 FOOT CANDLERS" are installed here—for just one vital purpose—to speed up Defense production.

LIGHTING is the most consistent revenue producer for utilities—because it contains so many desirable load characteristics. Now Ivanhoe "50 FOOT CANDLER" strengthens that claim — proves itself ideal for *selective load building* — because it is the first RLM *Continuous Wireway* Fluorescent Lighting System providing 50 foot candles (or better) of general illumination. For example—no less than 60 foot candles are being provided by the Defense installation illustrated above — with *more than a mile* of "50 FOOT CANDLERS" speeding production for Uncle Sam!

Industry—under terrific pressure for more production, lower costs and improved working conditions—is readily responsive to the benefits of this "better-seeing" lighting.

"50 FOOT CANDLER" CREATES SATISFIED LIGHTING USERS

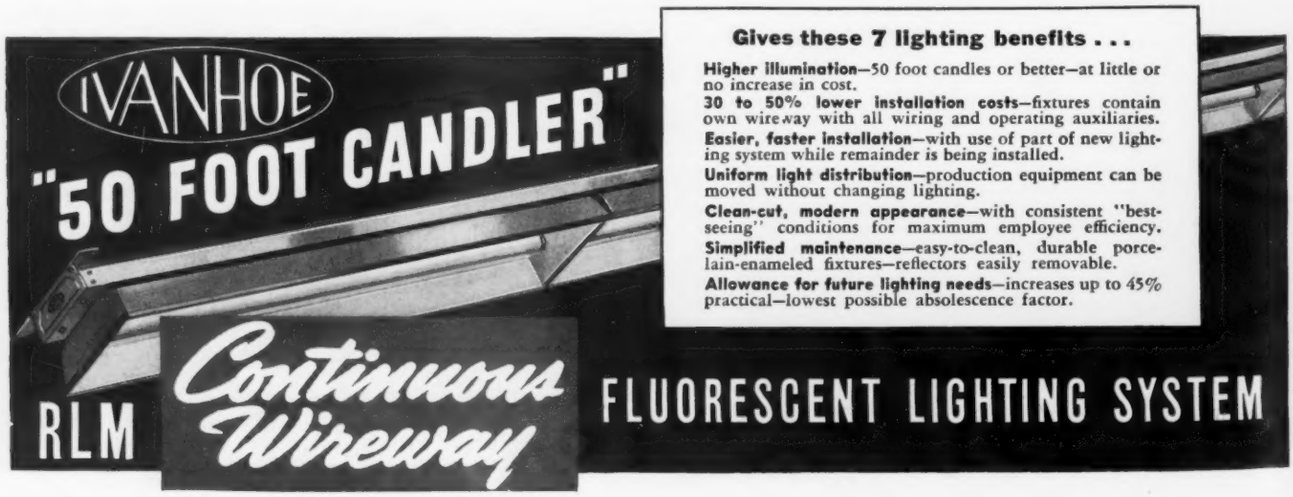
J. M. Shute of the Uxbridge Worsted Co. writes, " '50 FOOT CANDLERS' *increased our weaving efficiency on one type fabric from 81% to 84%, with a decrease of 22% in mending costs. On another type fabric weaving efficiency increased from 83% to 87.7%, with a decrease of 25% in mending costs.*"

This type of satisfied lighting user is a great asset to utilities. For what actually has happened is that Uxbridge is installing "50 FOOT CANDLERS" in *more* places, in *more* of its mills, and spreading the gospel. And, don't forget—when better lighting pays its users a profit . . . *they use it longer!*

Miller-Ivanhoe works constructively with utilities. *Have you seen our new Bulletins 1C and 2G?* WRITE . . .

THE MILLER COMPANY
MERIDEN, CONN.

Pioneers in Good Lighting Since 1844



Gives these 7 lighting benefits . . .

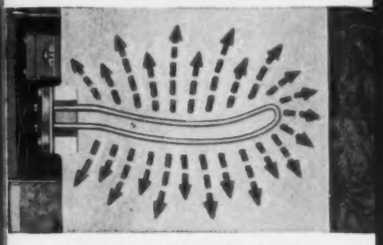
Higher illumination—50 foot candles or better—at little or no increase in cost.
30 to 50% lower installation costs—fixtures contain own wireway with all wiring and operating auxiliaries.
Easier, faster installation—with use of part of new lighting system while remainder is being installed.
Uniform light distribution—production equipment can be moved without changing lighting.
Clean-cut, modern appearance—with consistent "best-seeing" conditions for maximum employee efficiency.
Simplified maintenance—easy-to-clean, durable porcelain-enameled fixtures—reflectors easily removable.
Allowance for future lighting needs—increases up to 45% practical—lowest possible absolescence factor.

NOW...FAMOUS WESTINGHOUSE QUALITY

AT THE *LOWEST PRICES* IN WESTINGHOUSE HISTORY!

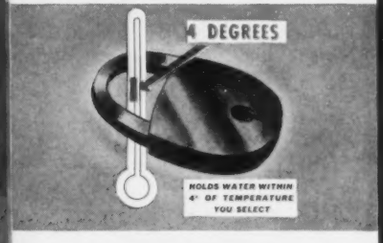
NEW "SPECIAL" MODELS

WITH THESE DELUXE SALES MAKING FEATURES



COROX ECONOMIZER HEATING UNIT

Famous for dependability. 99-75/100% of more than ¼ million Corox Units made in 12 years are still in operation!



SUPER ACCURATE THERMOSTAT

Automatically keeps water within 4° of temperature selected. Withstands tests equal to 51 years of trouble-free service in the home.

Plus *Improved Palco Fibre "A" Insulation, Scientific Baffle,* and many other quality features formerly found only on higher priced heaters!

FOR *BIG VOLUME* SELLING!

Yes! The "SPECIAL" is a NEW campaign model designed for *fast turnover!* Look at the selling "edge" it gives you: Famous Westinghouse quality features formerly found only in higher priced heaters . . . The sales making value of the "name that means everything in electricity" . . . plus new LOW PRICES that mean greater sales, higher profits this year.

Get details from your Westinghouse Distributor. See how the "SPECIAL" fits into the Westinghouse Line to give you a heater for every market requirement. Westinghouse Electric & Mfg. Co., Merchandising Division, Mansfield, O.

Westinghouse *Electric* Water Heaters

FROM THE *Leisure Line* OF ELECTRIC HOME APPLIANCES

NEW EQUIPMENT

Sodium Lamp Control

New sodium luminaire that turns itself on and off makes use of a phototube control that turns on the lamp at the approach of twilight, turns it off at the break of day. Luminaire is an open-sodium type, with 10,000-lumen lamp mounted horizontally. Phototube and associated equipment to operate the lamp from 120-volt, 60-cycle supply are located in compartment on back or pole-side of luminaire. Control is preadjusted at factory and compensated against flashes of light —such as lightning—that might affect the operation, it is stated.

Sodium luminaire with built-in phototube control. **General Electric Co.**, Schenectady, N. Y.

•

Mercury Switch

"Mercury midget switch"; for low-voltage circuits to 25 volts a.c. or d.c. and currents to 10 amp. at 6 volts and 3 amp. at 25 volts. **Littelfuse, Inc.**, Chicago, Ill.

Indicator circuits are among suggested applications for an extremely small mercury switch measuring $\frac{7}{16}$ in. long by $\frac{3}{8}$ in. in diameter. Newly designed baffle device is said to assure positive "make" or "break" action, without flickering.

•

Circuit Breaker

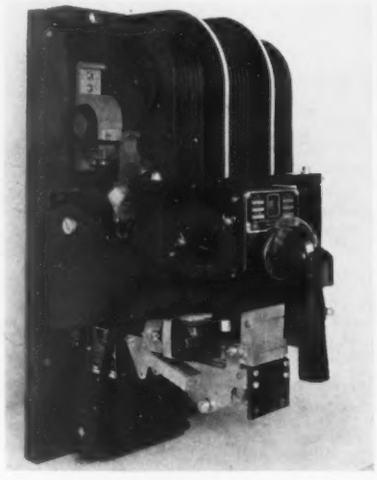
Type "AB-1" "De-ion" inclosed circuit breaker; in four frame sizes, with ratings from 15 to 600 amp.; voltage ratings from 250 volts a.c., 125/250 volts d.c. to 600 volts a.c., 250 volts d.c. **Westinghouse Elec. & Mfg. Co.**, East Pittsburgh, Pa.

Inclosed in water- and dust-tight sheet steel cases, new circuit breakers are said to require 40 per cent less mounting space than conventional fused safety switches of the same ratings. Operating handle is on front, to permit close banking. Silver contacts are operated by a toggle mechanism to provide a quick "make" or "break" action; bimetal thermal elements are used to prevent tripping due to harmless overloads.

•

Circuit Breakers

As an addition to their type "K" line this company has announced a new breaker, available either electrically or manually operated, in ratings to 225 amp., 250 volts d.c. or 600 volts a.c., with interrupting capacity of 15,000 r.m.s. amp. Various mounting types are offered.



Type "KA" circuit breaker; open-type three-pole unit shown, with phantom view of left-hand pole. **I-T-E Circuit Breaker Co.**, Philadelphia, Pa.

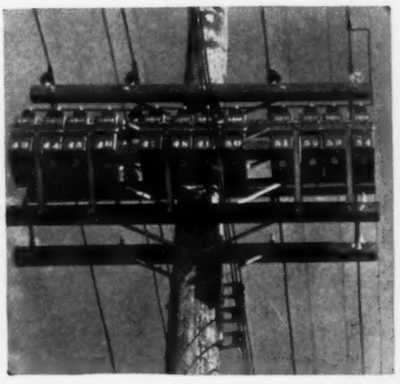
Who Makes What?

"Electrical Buyers Reference," published annually. **Electrical World**, 330 West 42d St., New York, N. Y.

Names, addresses and products of electrical manufacturers are catalogued in this convenient, annual publication for public utility, industrial, engineering and other major electrical buying interests.

Pole-Type Capacitors

Capacitors designed for standard pole mounting, either singly or in multiple units, feature an internal construction in which many small series-parallel connected sections are utilized, each with impressed voltage of less than 600. This construction is said to effect minimum heating, long life, absence of corona and a high factor of safety. Terminals are brought out through petticoats of wet-process, glazed porcelain, with Bakelite varnished gaskets at top and bottom. Available ratings include 5, 7.5, 10 and 15 kva. for single- and three-phase, 60-cycle lines to 575 volts.



Bank of "C-D" pole-type capacitors, totaling 180 kva. at 2,400 volts, three-phase, 60 cycles on a 4,160-volt wye circuit. **Cornell-Dubilier Corp.**, South Plainfield, N. J.

•

Plugs and Receptacles

New line of heavy-duty plugs, receptacles and cord connectors is announced for use

"Midget Triploc" plugs and receptacles: two-, three- and four-pole types, rated 10 amp., 250 volts; 15 amp., 125 volts. **The Pyle-National Co.**, Chicago, Ill.

FOR THAT SPRING CONSTRUCTION

"HANG THE LOAD ON HUBBARD HARDWARE"

HUBBARD AND COMPANY

PITTSBURGH . . . OAKLAND CALIFORNIA . . . CHICAGO

Sherman CONNECTORS

Precision Made!
of Finest Materials

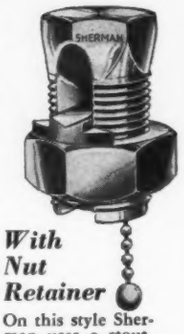
For Fast Assembly . . . Reliability and Surprising LOW COST!

Sherman makes a line of wire connectors and clamps that are designed and built to meet the specific needs of the light and power industry.

Every item is made for fast assembly and lasting electrical efficiency. Examine these connectors. Compare them part by part with competing goods. You'll see for yourself then, why Sherman today supplies such a large proportion of the connectors used in this field. Remember, too, Sherman connectors are remarkably low priced.

Split Bolt Connectors

Strong, clean, machine cut threads. Made from highest grade special alloy bronze, of greater tensile strength and greater corrosion resistance. Solid spacer that won't collapse, with greater bearing surface. Full hexagonal head. Long pilot. Two styles — with or without nut retainer.



With Nut Retainer

On this style Sherman uses a stout, kink-proof retainer that will stand a lot of rough handling. No radio interference. Ask for Bulletin No. 22.

Armor Rod Clamps

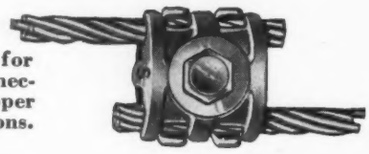
A new design for making tapoffs over ACSR Armor Rods. Cat. No. R1 for copper taps, Cat. No. R2 for ACSR or Galvanized Steel Strand Taps. Ask for Bulletin No. 25.

Wedge Grip Connectors

Made entirely of pure copper, and designed to provide extra wedging and snubbing action. Non-removable screw.

Jumper Clamps

A heavy, ribbed, parallel groove clamp for jumper, tapoff, service or other wire connections. Made in a range of styles, for Copper ACSR, or Galvanized Steel Strand connections. Ask for Bulletin No. 25.



"Bondrod" Ground Clamps

A very popular type clamp, for driven ground rods. Made of heavy, extruded bronze. Bronze screw with cup point. Strong, one-piece construction. Ask for Bulletin No. 22.

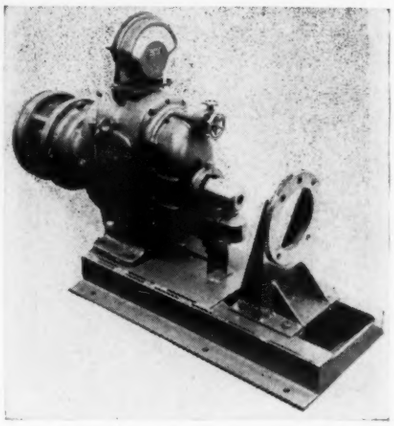
H. B. SHERMAN MANUFACTURING CO.
BATTLE CREEK, MICHIGAN

with portable electrical equipment. Two-, three- and four-contact units are interchangeable; three- and four-contact units can be furnished with one contact grounded for installations requiring an equipment ground wire. Contact units are reversible. Enclosed female contact may be assembled in plug shell or receptacle housing, depending on which is connected to "live" line side of circuit, protecting against the hazard of exposed "live" contacts.

•

Motor Test Rig

Generators, magnetos, governors, vibrators, pumps, springs, sewing machines, bearings and other varied types of equipment may be tested with this test rig which



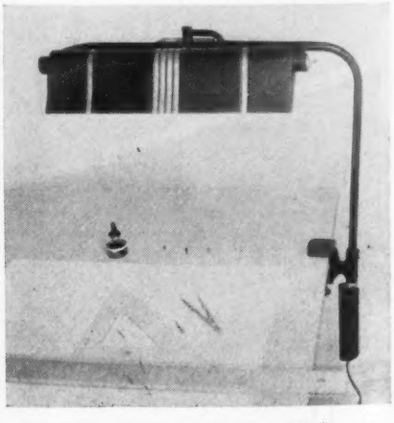
"P.I.V." gear test rig. Link-Belt Co., Chicago, Ill.

combines this company's "P.I.V." transmission unit and an adjustable mounting bracket. Equipment to be tested is placed in position on the mounting bracket, adjusted into position and then connected to the variable-speed output shaft of the transmission unit. Electric tachometer and calibrated speed indicator driven from the variable speed shaft provide means for observing speed of the mechanism under test. Two controls are provided: Direct hand wheel control and vernier control, through a secondary hand wheel.

•

Drafting Light

North daylight is approximated by this drafting light, according to the manufacturer, with a 15-watt daylight fluorescent



"Engineers Lite;" standard model for a.c. only. The Frederick Post Co., Chicago, Ill.

Mazda lamp. Pigment-treated reflector is designed to tone down the blue in the fluorescent lamp. Swivel arm may be set at any position from the table top to 24 inches. Shade is adjustable in a horizontal arc 360 degrees and 180 degrees in a vertical arc.

•

Industrial Fluorescent

"Super Two-Hundred" fixture for two 60-in., 100-watt lamps; 235 watts; 110-125, 199-216 or 220-250 volts a.c. **Day-Brite Lighting, Inc.**, St. Louis, Mo.

New industrial fixture is announced as first in series of fixtures for 60-in., 100-watt fluorescent lamps. It's available as a standard open-end unit with or without apertures, and as a closed-end unit with fill-in sections for continuous installations. Unit with apertures permits about 2 per cent of light to be thrown upward to ceiling.

•

Conduit Fittings

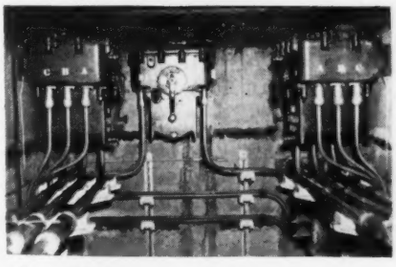
"Racolet" line of conduit fittings. **All-Steel-Equip Co.**, Aurora, Ill.

New line of conduit fittings is announced by this company. Line includes conduit bodies and covers, both standard and "FS" types, in threaded types for rigid conduit and threadless type for electrical metallic tubing. Explosion-proof and vapor-proof fittings are also offered.

•

Subway Breakers

Subway oil breaker is non-automatic, designed for wall mounting in subways, manholes or other places permitting total submersion. Main and arcing contacts of



Type "MS-2" subway oil circuit breaker; 2- and 3-pole, manually operated, non-automatic single-throw, 200 and 400 amp., 7.5 kv., 60 cycles. **Roller-Smith Co.**, Bethlehem, Pa.

inverted, high-pressure finger type. While the breaker is not intended for rupturing circuits, it may be closed in against fault currents and will withstand 18,000 r.m.s. amp. per phase for one second at 60 cycles, the manufacturer states.

•

For Recorders

"Daily Tear-Off Device for Micromax Strip-Chart Recorders". **Leeds & Northrup Co.**, Philadelphia, Pa.

This new device enables users of this company's strip-chart recorders to tear off and file a record of each day's operation. Rubber stamp can be furnished to identify the recorder and location of thermocouples. This permits daily assembling of records from various parts of a plant for comparison and study of interrelated effects.

Floodlight

Designed for general lighting purposes, this floodlight delivers a concentrated flood of light in a medium beam. It is essentially an incandescent bulb with an in-

"Floodlite" in "RE" short bulb: four sizes and four voltages from 100 to 300 watts, 110 to 125 volts. **Birdseye Lamp Sales Div., Wabash Appliance Corp.**, Brooklyn, N. Y.

side lining of silver for a reflecting surface. For localized lighting to supplement general illumination, detachable swivel socket focuses light where needed.

•

Switch Panels

"NTP" panels; in four to 40 circuits for 3-wire and for 3-phase, 4-wire services, with 2-wire, single (plug) fusing branches; snap-action switches, 30-amp., 125-volt, single-pole. **The Wadsworth Electric Mfg. Co.**, Covington, Ky.

Panels employ "push-pull" switches for individual circuit control, feature a removable interior block assembly. Both flush and surface mounting types are offered. Door for panels with 16 circuits or more have spring lock.

•

TECHNICAL LITERATURE

RADIO INTERFERENCE—Cause and elimination of radio interference on electric utility lines are considered in a new bulletin prepared by the Radio Interference Specialty Co., 116 New Montgomery St., San Francisco, Calif. Single-phase tap lines, tie wires, pin-type insulators, high-voltage bushings and rural lines are among trouble-sources considered.

A.S.T.M. PROCEEDINGS—Proceedings of the 1940 annual meeting of the American Society for Testing Materials includes in its 1,400 pages the committee reports and appended material presented at the meeting as well as the technical papers and discussions on the properties and tests of engineering materials. Seven reports involve non-ferrous metals including copper and copper-alloy wires for electrical conductors, electrical-heating, electrical-resistance and electric-furnace alloys. Three of the non-ferrous metals technical papers pertain to lead cable sheathing. Copies, in heavy paper binding, may be obtained from the A.S.T.M. headquarters, 260 So. Broad St., Philadelphia, Pa., at $8.50 each.

GENERATING UNITS—Installation drawings of recently installed steam generating units covering a wide range of capacity and pressure are included in a new catalog on Direct-Fired Systems published by Combustion Engineering Co., Inc., New York, N. Y. Improvements in mills and burners are also described and illustrated.

SLOWED DOWN by

TAPE TROUBLES?

Here's how GraybaR can help you!

1. FRICTION TAPE

First of all, by providing a source of top quality friction tape that is pre-tested at the factory. These tests are your insurance against ravelling and pinholes as well as assurance of proper aging, adhesion and strength. Thus, when you buy friction tape "via GRAYBAR" you get a full measure of insulation and protection.

2. RUBBER TAPE

Secondly, by a complete stock of the highest grade of rubber tape available. GRAYBAR rubber tapes contain no fabric whatsoever and, therefore, have an extremely high insulating value. Other advantages are their elasticity, resistance to aging and the ability to self-vulcanize into a solid watertight joint.

3. FREE BOOKLET

Thirdly, by offering to you, at no charge, a booklet giving the "down-to-earth" story of tests, grades and quality factors that will help you save money on tape. Write today for your copy of "What to Look For and Why" . . . simply address Graybar Electric Company, Graybar Building, New York, N. Y.

GRAYBAR IN OVER 80 PRINCIPAL CITIES

Distributed and guaranteed by GraybaR ELECTRIC COMPANY

NEWS ABOUT PEOPLE

W. H. Doran Assumes New Duties in Reading

W. H. Doran of Ithaca, N. Y., has been appointed vice-president of the Metropolitan Edison Co., with headquarters in Reading, Pa. Mr. Doran

went to the Metropolitan Edison Co. from the New York State Electric & Gas Corp., where he was a vice-president and division manager of the Ithaca division.

Mr. Doran was educated in Buffalo. He assumed his duties with the Metropolitan Edison Co. with 20 years experience in the utility business, beginning with the Depew and Lancaster Light & Power Co. as meter reader in Lancaster, N. Y. In 1934 he was made new business manager of the entire western New York group for New York State Electric & Gas Corp. and two years later he became division manager for that division. In 1937 he was transferred to the central division as vice-president and division manager, residing in both Geneva and Ithaca.

•

▶ LIEUT.-COL. L. G. SMITH has been called into service and has been sent to the School of Command at Fort Leavenworth, Kansas. He is assistant to the general superintendent of the Consolidated Gas Electric Light & Power Co. of Baltimore.

▶ CHARLES H. SILVESTER, formerly division manager of the Detroit Edison Co., at Lapeer, Mich., is now located at Port Huron, serving in the capacity of division manager of the combined Lapeer and Port Huron divisions.

▶ T. I. PHILLIPS has been appointed assistant to George H. Bucher, president of the Westinghouse Electric & Manufacturing Co. Mr. Phillips, formerly general works manager, will continue to be in charge of the headquarters manufacturing staff, the small motor, lighting and transformer divisions, and the construction department of the company, with headquarters in Pittsburgh.

▶ IRVING C. HARRIS, director of power at Boulder Dam since 1938, has been assigned to the Kennett division of the Central Valley Project in California to become senior engineer in charge of the installation of heavy power machinery at Shasta Dam.

▶ B. FRANK MORGAL, of Harrisburg, Pa., has been unanimously confirmed as a member of the Public Utility Commission by the Pennsylvania Senate. A veteran employee of the Public Utility Commission and the old Public Service Commission, Mr. Morgal was appointed to the commission last May by Governor Arthur H. James when a vacancy was created through the resignation of the chairman, Dennis J. Driscoll. His term runs to April 1, 1947.

▶ F. E. FAIRMAN, JR., has been appointed assistant manager of the switchgear division, central station department, of the General Electric Co., Philadelphia. J. D. HOFFMAN, also of Philadelphia, has been promoted to manager of sales of the equipment section in the switchgear division, taking over the work formerly handled by Mr. Fairman.

Four Promotions Made by Arkansas Power

Promotion of H. Fletcher Minnis of Searcy from manager of the northeast division of the Arkansas Power & Light Co. to operations manager with headquarters in the general offices in Pine Bluff and promotion of several local managers have been announced by C. S. Lynch, executive vice-president.

Mr. Minnis will assume part of the duties formerly performed by Frank M. Wilkes, who resigned as operating vice-president of the power company to become assistant to the president and general manager of the Southwestern Gas & Electric Co. in Shreveport, La.

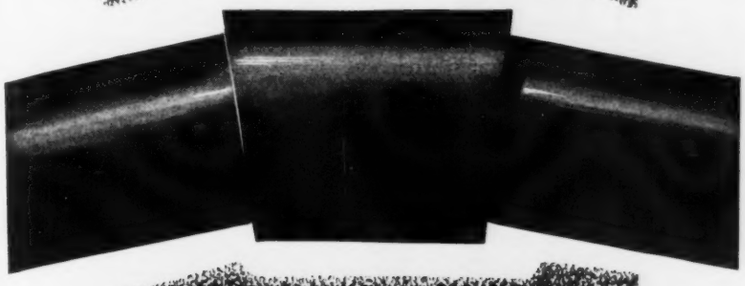
A graduate of the University of Arkansas in electrical engineering, Mr. Minnis spent a year taking a course for graduate engineers in the Westinghouse Electric & Manufacturing Co. factory. He started to work for the Arkansas

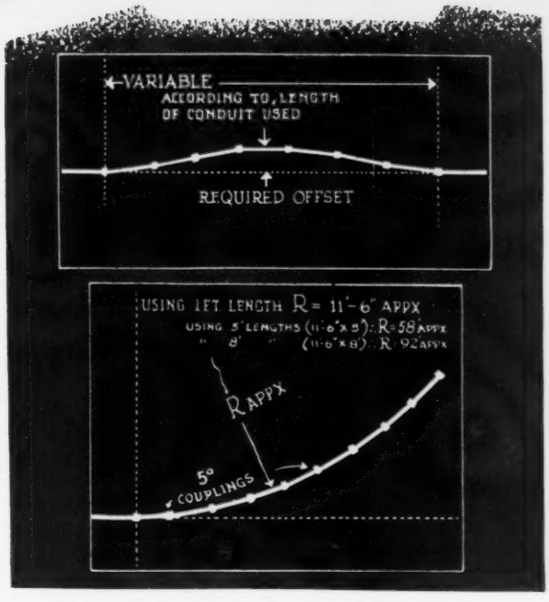
H. F. Minnis

Power & Light Co. as a commercial salesman in Louann, Camden, and El Dorado in 1924. Late that year he was promoted to manager of the northeast division with headquarters in Searcy.

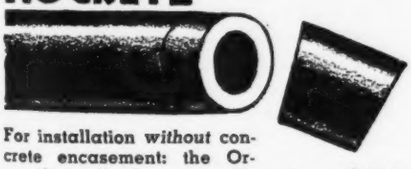
Ralph D. Caldwell, local manager at

ORANGEBURG OFFERS *New* SAVINGS WITH 5° ANGLE COUPLINGS




VARIABLE
ACCORDING TO LENGTH OF CONDUIT USED
REQUIRED OFFSET
USING 10' LENGTH R = 11'-6" APPX
USING 5' LENGTHS (11'-6"X5') R=58 APPX
" 8' " (11'-6"X8') R 92 APPX
R APPX
5° COUPLINGS

NOCRETE



For installation *without* concrete encasement: the Orangeburg dual-economy Nocrete conduit is recommended for service entrances, extensions, parkways and street lighting, suburban distribution, laterals, signal systems, etc.

STANDARD

For installation underground *with* concrete encasement: Orangeburg Standard Fibre conduit is recommended for duct banks (4 ducts and over), main distribution, high tension and "downtown" locations.

The dual savings in material and installation costs that have made both Orangeburg Standard and Orangeburg Nocrete preferred by practical buyers are now supplemented by a new saving originated by Orangeburg.

For now you can avoid obstacles, make bends, swings and offsets of varying size and direction in the field, on the job—at a fraction of the cost of special bends or ells—with the new Orangeburg 5° Angle Coupling.

And—like all other Orangeburg Couplings, this new fitting needs no jointing compound! Simply place the coupling on the tapered end of a section of Orangeburg, tap firmly with a mallet—and the accurately-machined Orangeburg Tapered Joint is water tight.

In terms of cable protection, this means that ground moistures, whether acid or alkaline, cannot penetrate the walls or joints and corrode the cable sheath. In terms of service, with all of its advantages Orangeburg's ultimate cost is still less than that of *any* other conduit manufactured.

Sales Agent—Distributors

Graybar Electric Co., Inc.

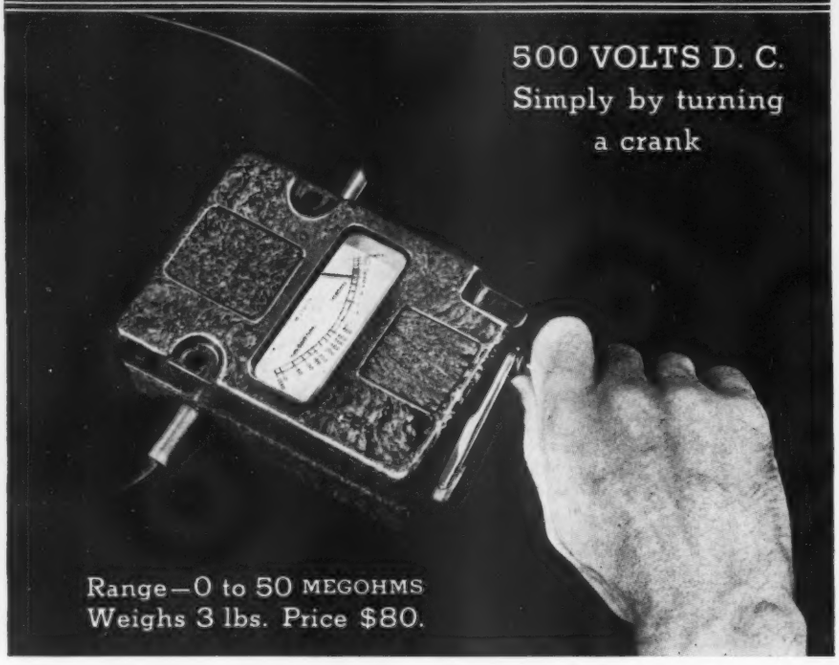
General Electric Supply Corp.

MADE AT ORANGEBURG, NEW YORK BY THE FIBRE CONDUIT COMPANY, 292 MADISON AVE., NEW YORK CITY

ORANGEBURG NOCRETE for installation without concrete encasement
STANDARD for installation with concrete encasement

MIDGET "MEGGER" INSULATION TESTER

TRADE MARK REGISTERED U.S. PAT. OFF.



Protection Against Electrical Breakdowns

Here is a testing device that should be used today by every maintenance man who is seriously interested in forestalling electrical failures. Detects dirt, moisture and deterioration in the insulation of practically all types of electrical equipment. No batteries or any "adjustments." Independent of all external current. Simply turn the crank; read the scale. Can be carried in pocket or tool kit and is ready for use *any time* and *any where*.

"Meg" Insulation Tester
"Megger" instruments of this type have ranges up to 2000 megohms with hand generators up to 1000 volts.

Our Midget "Megger" Tester as well as other types of hand-driven and motor-driven "Megger" Insulation Testing Instruments is described in new Catalog 1685-W just issued. Write for copy.

James G. Biddle Co.
1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

Camden, has been promoted to northeast division manager to succeed Mr. Minnis at Searcy. John Fitzgerald, local manager at Newport, has been promoted to manager at Camden, succeeding Mr. Caldwell and E. W. Lawrence, manager at Brinkley, has been made manager at Newport.

In announcing these promotions, Mr. Lynch said:

> These promotions are being made in line with the company's policy of advancing men from within the organization to higher positions when the opportunity permits and they are ready. Every one of these men has a fine record of service and we are happy we can fill each vacancy they left with others in our organization. We will continue this policy in the future.

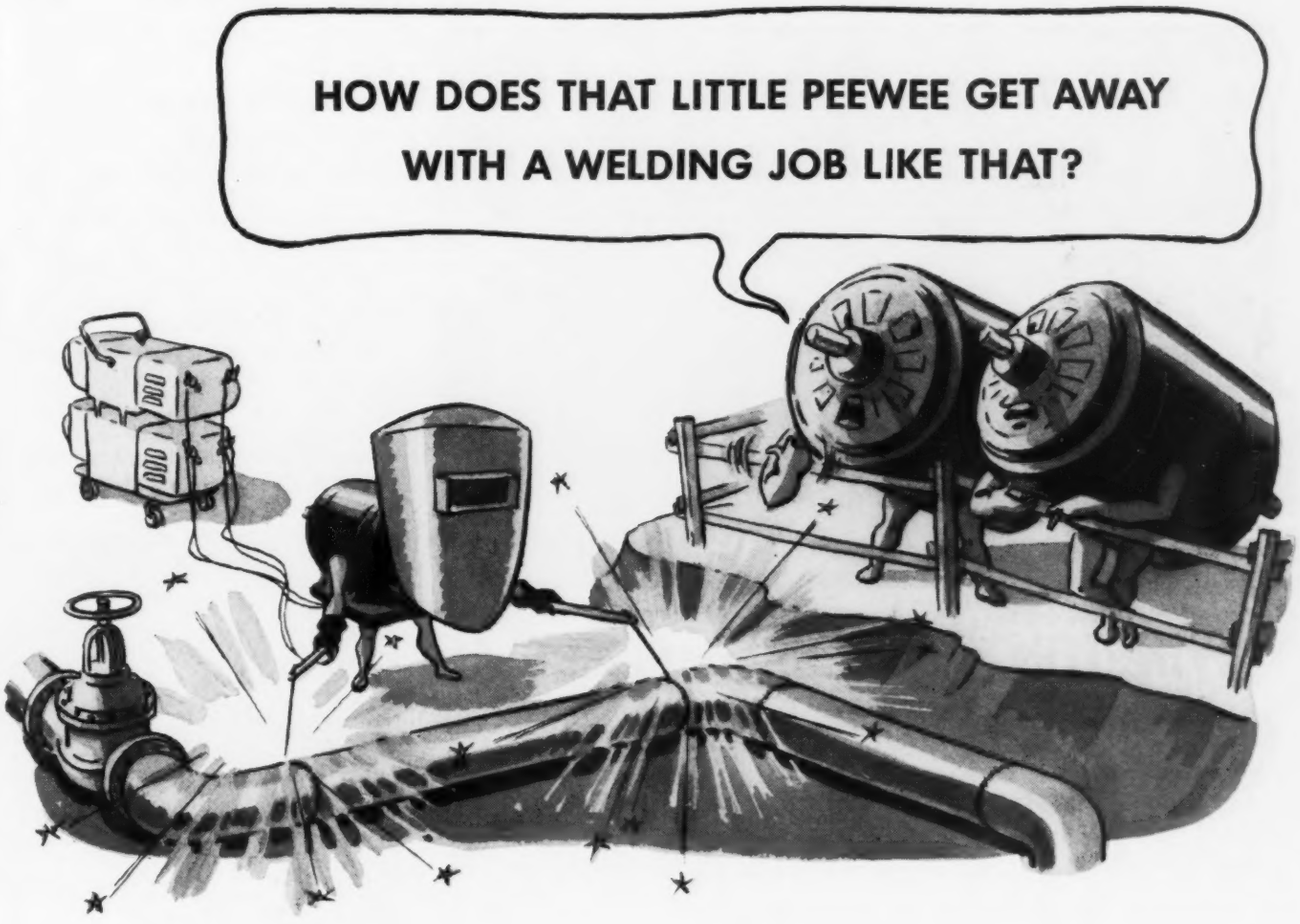
•

▶ LOUIS R. BOTSAI has been appointed manager of the gearing department at the East Pittsburgh division of the Westinghouse Electric & Manufacturing Co. For the past three years Mr. Botsai has been sales manager of the company's small motor division in Lima, Ohio.

▶ JOHN P. RAINBAULT has been named manager of the air conditioning and commercial refrigeration department of the General Electric Co. Formerly manager of the company's electric clock section in Bridgeport, Conn., Mr. Rainbault succeeds Stuart M. Crocker, who was recently named a vice-president concerned with customers relations. Mr. Rainbault's headquarters will be in Bloomfield, N. J. A graduate of the University of Paris, France, in 1909 with an electrical engineering degree, Mr. Rainbault joined the General Electric Co. in 1930 as New York district manager of radio sales. In 1931 he was transferred to electric clock sales activities and he had been manager of General Electric clock sales since 1932.

▶ J. C. SCHMIDTBAUER, northwestern district manager of the Westinghouse Electric Supply Co. at Chicago, has been elected a vice-president of the company. Mr. Schmidtbauer will continue to have headquarters at the northwestern district office and will act as consultant to J. H. Fisher, the new manager. He will also assist the company in its commercial relationships throughout its northwestern and northern districts.

His first job was with the Julius Andrae & Sons Co. in 1892. He was later made vice-president and general manager of the company and when in 1932 the organization was bought out by the Westinghouse Electric Supply Co. he was transferred to Chicago as manager of the northwestern district, a position he has held since.



How Fiberglas* insulated generators solved a welding problem—and the moral for you

A MANUFACTURER of arc welders had developed a new model.

It was small, inexpensive, and so designed that two men could weld from the same unit at the same time. This meant two leads and of course a correspondingly larger output of current from the generator. But here was the hitch.

An ordinary cotton-insulated generator, large enough to deliver the output wanted, made the unit cost too high. A smaller generator brought the cost in line, but burned out when both leads were in use.

The problem was to find a smaller generator with a Class B insulation which was inexpensive to install . . . which would resist the high temperature developed at 3600 r.p.m.—the speed at which the generator ran to deliver the welding current needed.

The arc-welder manufacturer found such an insulation in Fiberglas. Used it on the magnet wires of the smaller generator. And of the scores in use today, *not one has failed*. Some of them work on 24-hour schedules.

This case history spotlights two mighty important superiorities of Fiberglas.

Here is superiority #1

Several important manufacturers are now making *smaller-size* Fiberglas-insulated motors and generators. And these still have a *substantially larger safety factor* than ordinary units insulated with Class A materials, even though they operate at approved higher temperatures. Their cost is a little more in some cases—often no more.

Or, by changing from Class A to Fiberglas insulation, you can get the *maximum safety factor* in *standard-size* motors and generators.

Now for superiority #2

If you have tough jobs around your plant, you get a highly superior "tough job" electrical insulation in Fiberglas. For Fiberglas resists heat, chemical vapors, moisture, and most types of process dust *better than ordinary electrical insulations*.

So, don't forget! Downtime costs money. Holds up defense production. And with machinery operating more hours at higher speeds, you can't afford to take the chance on breakdowns.

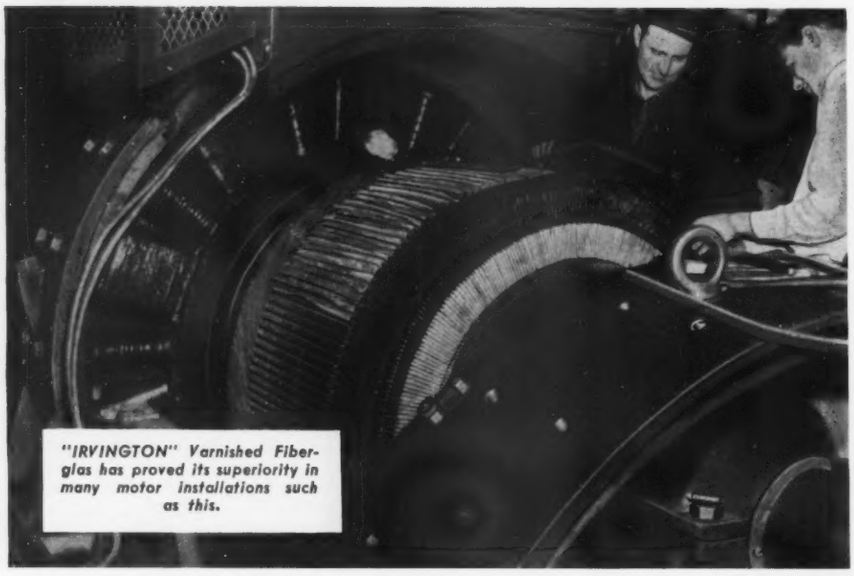
You need an increased safety factor! Specify Fiberglas Electrical Insulation. *Owens-Corning Fiberglas Corporation, Toledo, Ohio.* In Canada: *Fiberglas Canada Ltd., Oshawa, Ontario.*

OWENS-CORNING

FIBERGLAS*

*T. M. Reg. U. S. Pat. Off.

TO ELECTRICAL ENGINEERS: The use of Fiberglas insulation in these arc welders should suggest to you other places where the dependability and unusually great safety factor of Fiberglas can help solve your insulation problems. Available in all standard insulation forms. Write us for further details.



"IRVINGTON" Varnished Fiberglas has proved its superiority in many motor installations such as this.

"IRVINGTON" VARNISHED FIBERGLAS

Better Insulation More Easily Applied

"IRVINGTON" Varnished Fiberglas makes powerful motors smaller and lighter and tiny instruments more efficient and long-lived. It allows hundreds of types of electrical equipment to operate more efficiently, for more years, at higher temperatures, with greater resistance to attacking elements.

"IRVINGTON" Varnished Fiberglas is properly impregnated and coated with insulating varnish of highest grade to withstand the severe abuse which Fiberglas permits.

Here is glass cloth, woven from continuous fibers as manufactured by Owens-Corning Fiberglas Corporation; then thoroughly impregnated and coated by Irvington with high heat resisting black or clear insulating varnishes developed especially for this purpose.

To secure the benefits of highest insulation resistance, resistance to impact and abrasion, and the best balance in overall mechanical, electrical and chemical characteristics, the Fiberglas you use should be factory impregnated by Irvington's modern methods and with "IRVINGTON" High Heat Resisting Insulating Varnishes.

This superior product comes to you all ready to go in place, eliminating costly, time-consuming varnish impregnation and coating operations in your plant.

Detailed technical data and specifications for standard "IRVINGTON" Varnished Fiberglas cloths and tapes are yours for the asking. Data will gladly be furnished on the development and production of special combinations of Fiberglas cloth and varnish.

IRVINGTON VARNISH & INSULATOR CO.

IRVINGTON INSULATION

IRVINGTON, NEW JERSEY, U. S. A.

PLANTS AT IRVINGTON, N. J. and HAMILTON, CANADA

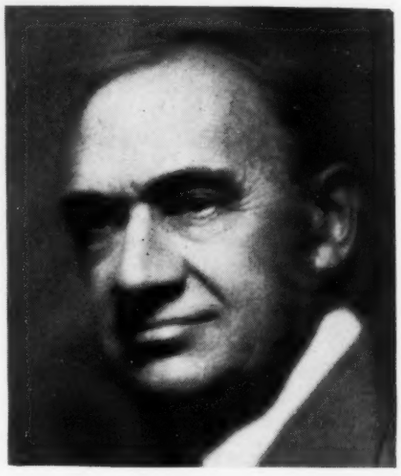
Representatives in 20 Principal Cities

OBITUARY

Charles A. Stone

Charles A. Stone, co-founder and chairman of the board of Stone & Webster, Inc., whose death was announced in the March 1 issue of ELECTRICAL WORLD, page 15, was born in Newton, Mass., in 1867. He entered the Massachusetts Institute of Technology in 1884 as a member of the pioneer course in electrical engineering. It was during this period that he began his lifelong association with Edwin S. Webster, a classmate.

In 1889 Mr. Stone formed a partnership with Mr. Webster, under the name



of Massachusetts Electrical Engineering Co., Stone & Webster, managers. In 1890 the firm obtained its first engineering and construction contract, the pioneer Saccarappa, Maine, hydro-electric installation and transmission line, a contract which launched Stone & Webster in the engineering and construction field, which has remained a most important phase of the business. During a period of reorganization in the utility field, Stone & Webster gave effective assistance and before long the firm was asked to assume actual management of electric light and power plants, electric railways, water supply systems, etc. At the turn of the century, the rapidly growing utility industry was having difficulty in raising sufficient capital. Stone & Webster began financing companies committed to their charge. The experience gained in this work led the company into the general investment banking field, where its functions, following the acquisition of Blodget & Co. in 1927, have been carried on by Stone & Webster and Blodget, Inc.

In 1916 Mr. Stone was chosen president of the American International Corp., created primarily for extending the influence of American finance and

The 15th edition of this book is a veritable encyclopedia on Central Station practice—invaluable as a sales aid and engineering reference for manufacturers and distributors selling to this field, for consulting and power-sales engineers, public service commissions, financial houses. For the central stations themselves, it is an up-to-the-minute roster of the men in other plants whom they are anxious to keep in touch with for personal or business reasons.

This Latest Edition is a complete directory, classifying geographically all operating and holding companies in North America and U.S. possessions; also all plants, both privately and municipally owned. It contains an alphabetical index to all companies listed—over 4,000 of them. Listings include names and titles of all responsible officials; full data on power generation, transmission, distribution, number of meters, etc.

800 pages, strongly bound in flexible blue Fabrikoid; thumb indexed; size 4½ inches by 8½ inches. Published annually. Price $25.00 per copy. 10% discount on 5 or more copies.

Your Answer Book When You Want definite Information

on the Electric Utility Industry, such as—

...the name of the operating company or companies serving a given community

...the communities served by a given company

...the number of meters connected

...the number of rural customers

...ratings and types of units in generating plants

...type of distribution system and principal distribution voltage

...inter-company energy purchases

...names of the administrative, managing and operating officials listed by title for each of the companies

...information on holding companies, with cross-reference explaining the relationship with the operating company

In short, here's your most comprehensive, up-to-the-minute guide to the more than 4000 electric systems, private and municipal, in the United States, Canada and United States possessions.

Plant Equipment and Operating Data—The Central Station Directory lists for every plant its total generating capacity; the types and capacities of all prime movers and generating units; the voltages, phases, cycles and wiring of the distribution system; total number of meters connected, etc.

Personnel Data—The Directory lists all administrative, managing and operating officials by name and title.

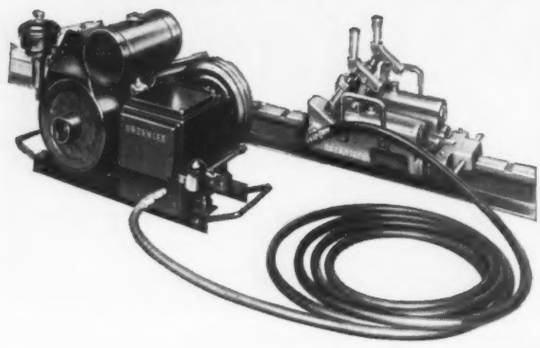
Company Interlock—Full holding company data are given, with cross-reference explaining the relationship.

McGRAW-HILL PUBLISHING CO., 330 WEST 42ND ST., NEW YORK CITY

Catalog and Directory Division

ANNOUNCING!

A POWER PUMP FOR GREENLEE HYDRAULIC PIPE PUSHERS



Here is the new Greenlee No. 796 Motor-Driven Reciprocating Pump for driving Greenlee Pipe Pushers. With this pump, pipe can be pushed as much as four times faster than by manual pumping. One man can easily operate the pump by watching the pusher and controlling the pressure with a cord attached to the control lever.

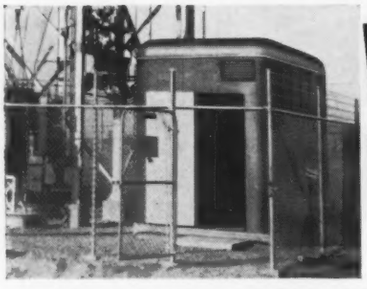
The pump, shown here attached to the Greenlee No. 790 Pusher, driven by a 1¾ H.P. gasoline motor, forces oil through a hose to the hydraulic power unit and into the cylinders which force the power unit forward on the base. A spring-controlled by-pass lever regulates the flow of oil to the power unit.

SEND FOR NEW S-117 PUSHER BULLETIN

Just off the press . . . new S-117 Bulletin with complete description of the Greenlee Line of Hydraulic Pushers. Send for free copy!

GREENLEE TOOL CO., 1705 Columbia Ave., ROCKFORD, ILL.

BUTLER READY-MADE STEEL BUILDINGS



BUILD OR EXPAND YOUR PLANT IN A HURRY!

READILY INSULATED--HEATED OR AIR-CONDITIONED!

SIZES 4'x6' TO 100'--ANY LENGTH--ROUND OR GABLE ROOF

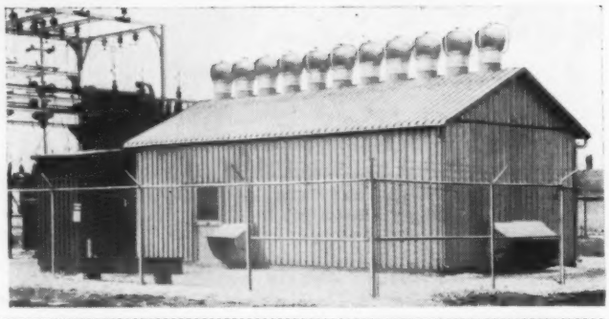
INSTALL IN DAYS INSTEAD OF WEEKS!

LESS INVESTMENT --QUICKER CHARGE-OFF!

The **BUTLER BOULEVARD BUILDING** above is 8' x 12' x 8'6" and houses **SUB-STATION** control equipment. It has double panel steel walls—Steel inside and outside—with insulation between and available in many strikingly beautiful functional designs.

The **BUTLER ALL-PURPOSE BUILDING** at right is 16' x 34' x 10' and houses **SYNCHRONOUS CONDENSER** high voltage control equipment. Ventilated for 20,000 cu. ft. air displacement per min.

Before you build get full facts on this 25 year old development in factory fabricated steel buildings.



BUTLER MANUFACTURING COMPANY

1270 Eastern Ave., Kansas City, Mo. **970 Sixth Ave., S. E., Minneapolis, Minn.**

Send Steel Building Book and Data on.....
Type Building, Size.....
ft. x..... ft. x..... ft.

Firm Name .....
Address .....
City ..... State .....

commerce in foreign countries, and which acquired extensive interests in many important undertakings. Mr. Stone continued at its head until after the World War. In 1925 he arranged the purchase of the Virginia Electric & Power Co. from the Gould interests, and with it as a nucleus formed the Engineers Public Service Co., of which he was chairman for several years. For a brief period Engineers Public Service was a subsidiary of Stone & Webster, but following the enactment of the Public Utility Holding Company Act this interest was disposed of and Mr. Stone retired as chairman and director of the Engineers Company.

Mr. Stone served as a director of the Federal Reserve Bank of New York from 1919 to 1923 and for many years as a director of many banking, public utility and industrial companies.

•

▶ LUCIUS H. FISHER, retired credit manager of the Wisconsin Gas & Electric Co., died January 23 at his home in Racine, in his sixty-eighth year. Mr. Fisher was credit manager for the utility for fifteen years before his retirement in 1938 because of ill health.

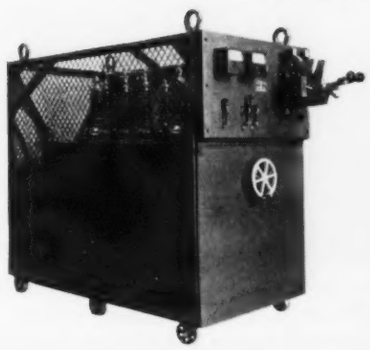
▶ JOSEPH J. BLACKMORE, a charter member of the American Society of Heating and Ventilating Engineers, who was secretary of the United States Radiator Corp. of Detroit from 1910 until his retirement in 1915, died February 12, after a brief illness, in Brooklyn, N. Y. Born in Yorkshire, England, 84 years ago, he was brought to Toronto, Ont., in his boyhood. Mr. Blackmore was a life member of the American Society of Heating and Ventilating Engineers since 1930 and had contributed many papers to its meetings and served on the council and various technical committees.

▶ RILEY E. ELGEN, chairman of the Public Utilities Commission of the District of Columbia, died suddenly at his home in Washington on February 28. He was 59 years old. Mr. Elgin was first appointed to the commission by President Hoover in January, 1932, and was reappointed by President Roosevelt. On his appointment to the board Mr. Elgen was chosen vice-chairman, and was named chairman when Gen. Mason M. Patrick resigned. He was selected originally for the commission position because of his long experience in utilities work with the Interstate Commerce Commission, with which he was associated from 1916 to 1932, the last ten years as valuation engineer. Following graduation from St. John's College, Annapolis, in 1903 Mr. Elgen spent several years in the transportation field.

AMERTRAN TRANSFORMERS

Portable set designed to permit laboratory tests on transformer oil in the field — AmerTran Type TS-6D.

Heavy Duty test set for the commercial laboratory, utility or manufacturer; 10 Kva., 100 Kv.— AmerTran Type TS-10A.



The importance of dielectric tests on insulation and equipment at regular intervals and with *dependable* apparatus cannot be overestimated. Such tests not only are your best insurance for uninterrupted service but also are essential for the protection of human life and valuable property.

For four decades many leading electric utilities, equipment manufacturers, universities and testing laboratories have depended upon AmerTran for high-voltage testing apparatus. During this time our engineers have thoroughly studied testing problems of all types and have developed transformers and complete sets for both light- and heavy-duty testing. Standard designs are available to meet the most specialized requirements of the research worker, commercial testing laboratory, maintenance man and electrical manufacturer.

Consult with AmerTran on all problems involving equipment for testing electrical insulation, whether it be paper, tape, oil, rubber and pressboard in the pre-fabricated state or in assembled products such as motors, generators and cables. Let us submit complete data on apparatus for your needs.

AMERICAN TRANSFORMER COMPANY
178 Emmet St., Newark, N. J.

AMERTRAN

MANUFACTURING - MARKETS

General Electric Net Equals $1.95 a Share

Net sales billed by General Electric Co. for 1940 totaled $411,938,000, as against $304,680,000, according to President Charles E. Wilson in a preliminary report of operations. Orders received totaled $654,190,000, a record high, and were 81 per cent more than received in 1939.

Net income for 1940, after provision for all charges, amounted to $56,241,000, equivalent to $1.95 a share on the common stock. This compares with $1.43 a share in 1939. Cash dividends of $1.85 a share were paid in 1940, against $1.40 a share paid in 1939.

Directors have declared a dividend of 35 cents a share, payable April 25 to stockholders of record on March 14. This is the same as paid in the first quarter of last year.

The provision for total 1940 taxes was $54,943,000, or more than was ever previously required for such purposes and represented an increase of $33,930,000, or 162 per cent, over the 1939 total, Mr. Wilson declared.

On December 31, 1940, there were 214,140 stockholders, compared with 209,914 a year earlier.

The annual report for 1940 will be mailed to stockholders in the latter part of March.

•

Show Increased Net; Record Backlogs

Consolidated net income of General Cable Corp. for 1940 after deductions for depreciation, bond interest and federal income taxes, but before preferred dividends, was $2,455,362. This compared with consolidated net income of $731,166 before preferred dividends in 1939. The annual report discloses that all facilities of the company are engaged to some extent in defense and that other lines are active.

Among the other manufacturing companies issuing reports covering 1940 operations are the following:

BLAW-KNOX—Including its wholly-owned domestic subsidiaries, net profit after excess profit taxes, $1,360,747, equal to $1.02 a share on 1,334,458 shares of no-par capital stock. Net profit for 1939 was $954,424, or 71 cents a share. Net sales last year aggregated $18,481,802, compared with $13,065,144 for 1939. Backlog of unfilled orders now totals $15,159,000, the largest on record.

CLARK CONTROLLER—Net profit, $374,449, equal to $2.38 each on 157,144 shares of common stock, compared with $164,459, or $1.05 a share in 1939. P. C. Clark, president, in a letter to stockholders, indicated that the volume of unfilled orders on hand at the beginning of the current year was the largest in the history of the company and that about 80 per cent of this volume is for national defense purposes.

MINNEAPOLIS-HONEYWELL REGULATOR—Net income, $2,528,602, equal after preferred stock dividends to $3.87 a share on 621,900 no par common shares outstanding. Net income for 1939 was $2,158,582, or $3.27 a share. Sales totalled $15,933,565, compared with $14,004,947 the year before.

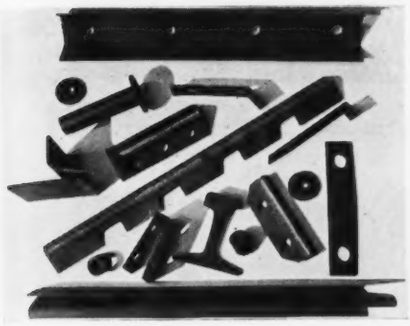
Refrigerator Sales Spurt in January

Domestic sales of household electric refrigerators during the month of January by twelve manufacturers totaled 349,901 units, compared with 218,250 units in January, 1940, by sixteen manufacturers, an increase of 60 per cent, according to figures released by the National Electrical Manufacturers Association.

Total world sales in January amounted to 363,558 units, compared with 227,822 units in the similar month last year. Canadian sales were 4,363 units, against 3,302 units in January, 1940, and other foreign sales totalled 9,294 units, compared with 6,270 units in the similar month last year.

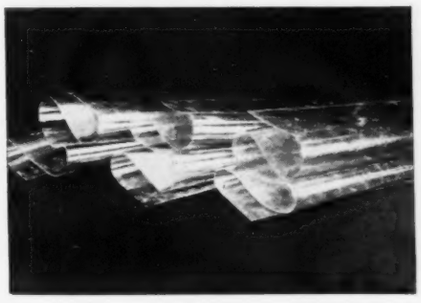
Sales of electric ranges by manufacturers continued to show a substantial increase over the previous year in January, according to the report issued by the National Electrical Manufacturers. The total sold by eighteen manufactur-

SALES MEETING—Dunco Relay sales representatives from all parts of the United States and Canada at the sales convention of Struthers Dunn, Inc., Philadelphia, held at the Penn Athletic Club to discuss plans. A number of new relay and solenoid developments was presented at the meeting



Vulcanized Fibre helps make train travel safe - - -

The efficient operation of block signal systems depends upon the Vulcanized Fibre track insulation. It must be tough — must have high dielectric strength—must not cold flow—must stand up under terrific vibration and torsional strain, and must lend itself to forming, machining and punching. There is no other electrical insulating material that will stand up in this use. If you have an insulation problem where the insulating material must take a terrific mechanical beating—get all the facts on DIAMOND Vulcanized Fibre. Send for folder SP 12.



For quick effective repair jobs.

Micabond "55" is a flexible built up mica sheet—ideal for permanent and temporary repair jobs . . . and many other insulating needs requiring a flexible insulation . . . high in heat resistance, extremely flexible at ordinary room temperature, retains its flexibility even after long periods of storage . . . is not tacky, and will not become tacky. Ask for descriptive folder MD-12 for more information about other MICABOND grades.

Electrical Devices
last longer when the insulation
is C-D Engineered

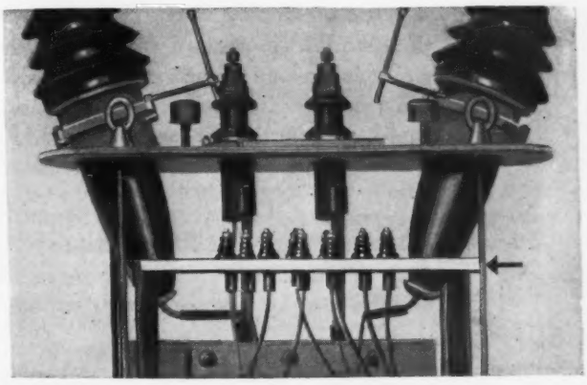
Electrical Insulation designed and produced to meet your specific problem is what we mean when we say C-D Engineered.

THIS SERVICE IS BASED ON

1. We have been doing Laboratory Research work on Electrical Insulating Materials since 1911.
2. . . . we have thousands of case histories of solved electrical insulating problems . . .
3. We make many types of insulating materials so our experience has been broad and we are not tied down to trying to make one or two particular types of material work.
4. Our Laboratory facilities are complete—including weather maker for humidity tests—high voltage equipment—physical strength testing — heat and chemical resistance.

The C-D Laboratory is ready to study your problem . . . If no standard electrical insulating material will solve it we will develop one that will . . . Write—wire or telephone us at 12 Chapel St., Newark, Delaware.

Dilecto changer panel in transformer



Send for this booklet!

Just off the press . . . includes a ready reference chart showing best type of electrical insulating material to use for specific problems . . . gives complete data on standard sizes, forms, colors and finishes of C-D Insulating Materials. Ask for folder GF-12.

Continental = Diamond FIBRE COMPANY

"Manufacturers of Laminated Plastics Since 1911" — NEWARK • DELAWARE

FOR VAULT AND MANHOLE PROTECTION

HOW do you handle underground fires? What do you do about trouble in manholes and underground transformer vaults?

Get a fire extinguisher that reaches deep down, whose penetrating power extends to every inch of vault or manhole, and which can kill fire even in inaccessible ducts.

This newest type LUX trailer unit is engineered for these hard-to-fight fires. Heavy barrage against fire is supplied by the six 50-pound LUX carbon dioxide cylinders equipped with a 100-ft. hosereel and heavy-duty nozzle. Individual cylinder controls permit discharge of a single cylinder or an entire broadside of 300 lbs. of carbon dioxide gas. Small portables are carried, too.

Hook this new LUX unit onto an emergency truck, and you're ready for underground fires. Fast-expanding LUX gas has the "reach" to travel a hundred or more feet and kill duct fires . . . has the wallop to smother the hottest vault or manhole fire.

Get one of these mobile fire-killers in your garage. Write now—and we will send full details by return mail.

LUX SNUFFS OUT FIRE

Walter Kidde & Company
INCORPORATED

328 West St., Bloomfield, N. J.

ers in Continental United States, Alaska and Hawaii was 50,516 units, an increase of 38.7 per cent over the 36,395 sold in January, 1940, by nineteen manufacturers.

•

Begin to Build $700,000 Atlanta Branch Plant

Westinghouse Electric & Manufacturing Co. has begun excavations for a new factory branch, storage and distributing plant at Atlanta, Ga., for which a general contract has been awarded to the Rust Engineering Co., Clark Bldg., Pittsburgh, Pa., estimated to cost approximately $700,000.

The plant will be located on a six-acre tract of land on Northside Drive, fronting on line of the Southern Railway, and will consist of one, two and three-story buildings, designed for requirements of all departments of operation and company headquarters in this district. Structure will be air conditioned, with glass block walls, equipped throughout with fluorescent lighting facilities. Robert & Co., Atlanta, are architects and engineers.

•

Foster Wheeler Dividend

Directors of Foster Wheeler Corp. have declared a quarterly dividend of $1.75 and a dividend of $7 applicable to arrears on the $7 preferred stock, both payable April 1. This will mark the first payment on the preferred issue in over eight years, the last previous disbursement having been $1.75 quarterly on January 2, 1933.

•

Complains Against Union

Allis-Chalmers Manufacturing Co. has filed a complaint with the Wisconsin Employment Relations Board against striking UAW workers. The company, holding large defense contracts, charged the union with unfair labor practices, alleging that the union's strike vote was not conducted by secret ballot, that the question submitted for balloting was ambiguous and confusing and that the union deliberately changed words of the ballot to confuse the workers.

New York Metal Prices

	March 4, '41 Cents per Pound	Feb. 26, '41 Cents per Pound
Copper, electrolytic	12.00*	12.00*
Lead, A. S. & R. Price	5.75	5.65
Antimony	14.00	14.00
Nickel, Ingot	35.00	35.00
Zinc Spots	7.64	7.64
Tin, Straits	51.25	51.375
Aluminum, 99 per cent	17.00	17.00

*Delivery Connecticut Valley.

See for yourself, "What a Finish!"

ALZAK* aluminum REFLECTORS

DEFENSE COMES FIRST

To meet the needs of the National Defense Program, plus the normal demands of peace, a vast expansion of our already greatly increased production capacity is being speeded. When the emergency is past, there will be more Aluminum available than ever before.

Meanwhile, if you can't get all the Aluminum you want when you want it, remember Aluminum is helping you by helping to meet the National emergency.

Lighting gets off to a handsome start when it's backed up by Alzak Aluminum reflectors. Look at the surface of this sheet as it comes from the Alzak finishing bath; the most efficient light-directing surface you can get.

And Alzak Aluminum reflectors retain this high reflectivity year after year to a remarkable degree. There's no chipping, because the smooth, glasslike, hard oxide coating is an integral part of the metal. They are no trouble to keep clean; simply wash with soap and water.

With Aluminum, the manufacturers shape their reflectors exactly to meet the requirements of their designs. You can get any reflecting surfaces you want, whether diffuse, specular or combinations of the two. Some Alzak reflectors are intended for indoor use, while others are able to withstand out-of-door exposure. Whatever your use, be sure to specify the right Alzak finish for each job.

. . .

You can identify a genuine Alzak Reflector by a label affixed to it by the manufacturer. This lists the patents protecting the processes that assure uniform, high quality workmanship. Look for that label when you are buying reflectors.

ALCOA

*Reg. T. M., Alum. Co. of Amer.

ALUMINUM COMPANY OF AMERICA

1978 GULF BUILDING • PITTSBURGH, PA.

ASPLUNDH

Line Clearing may be a nuisance for you but it's a business with us—a business we know from the practical angle, the public good-will angle and the money-saving angle. One of our several contracts will fit your needs . . . Write for them today.

—BRANCH OFFICES—

CHICAGO, ILLINOIS
Randolph 7773
BINGHAMTON, N. Y.
Binghamton 4-5314
COLUMBUS, OHIO
Adams 5432
WASHINGTON, D. C.
Shepherd 6115
BALTIMORE, MD.
Plaza 7656
ALEXANDRIA, VA.
Alexandria 3581
PITTSBURGH, PA.
Atlantic 9798
NEW CASTLE, PA.
New Castle 2285
RUTHERFORD, N. J.
Rutherford 2-7434
CAMBRIDGE, MASS.
Kirkland 5330
DURHAM, N. C.
Durham X-5503

TREE EXPERT COMPANY
JENKINTOWN,
PENNSYLVANIA
OGONTZ 3750

Line Clearance Exclusively

Field Reports on Business

Orders for electrical goods and supplies continue in good volume. Big problem is getting production speeded to keep pace with incoming orders. Utilities are buying a wide range of equipment. Efforts are being made to discourage stocking of large inventories.

NEW YORK

Efforts to build up inventories are meeting with strong opposition because of the urgent demands to meet present sales. Orders for electrical equipment continue in increasing volume, with delivery dates becoming more uncertain. Defense contracts are crowding domestic needs, with prospects that "business as usual" will be pushed into discard.

Westinghouse has received an order of $250,000 for two hundred 55-hp. high-speed motors and control equipment for 50 streamline cars for St. Louis Public Service Co. Westinghouse's New York offices will move about April 15 to its new quarters at 40 Wall Street.

General Electric has produced its 500,000th washing machine at Bridgeport, Conn.

Washing machine manufacturers are appearing worried over shortage of important metals and are hunting for substitutes. Plastics are now being used as agitators. Westinghouse has discontinued three refrigerator models because they use large quantities of aluminum. Others are expected to follow. Some substitute is being sought. The advance in price of refrigerators has failed to slow consumer purchases. Buying started earlier this year and has continued at a fast clip.

Utilities are buying regulators, pilot exciters, transformers, switchgear, breakers, synchronous condensers and cable. A few generators have been ordered and more are in the inquiry stage.

Government buying of electrical equipment continues at a good pace. Recent orders include cable, motor-generator sets and miscellaneous equipment.

NEW ENGLAND

Orders for electrical equipment and supplies are moving ahead at a good pace. Factory expansion is active. Fifteen concerns expending $59,324,562 for plant expansion, construction and equipment had received government awards up to February 1. General Electric has about 80 per cent of its present production rated as war work nad is employing 14,000 in the greater Boston area with a weekly payroll of $600,000. This company has under construction, or has recently completed, additions costing $2,000,000 and is adding machine tools at a cost of from $7,000,000 to $10,000,000. Last week the Navy Department recommended an allotment of $8,500,000 for expansion of the G.E. Pittsfield plant.

Government awards announced recently include a $195,256 electric cable contract to Collyer Insulated Wire, $62,652 submarine cable contract to Simplex Wire & Cable, $25,017 to Winsted, Conn., Division-Hudson Wire Co. for magnet wire and $5,145 to American Electric Supply Co., Boston, for electric cable.

Reynolds Metals Co. has placed a large order for air-handling equipment with B. F. Sturtevant Co. to be installed in its new Birmingham, Ala., plant. Bird Machine Co., Walpole, Mass., has been awarded contract for $11,174, and Thomson-Gibb Electric Welding Co., Lynn, has received an order for welders totaling $6,474.

More than 300 electric ranges have been distributed throughout this district by one representative since January 1. A 21-suite Bay State apartment house will be all-electric and has a 9-kw. range for each suite.

PACIFIC COAST

Major electric appliance sales by units in 1940 in the typical territory served by Pacific Gas & Electric Co. in northern and central California show increases over 1939 sales of 20 per cent for washers and radios, 15 per cent for ironers, 10 per cent for ranges and 45 per cent for refrigerators. Dealer commitments for 1941 have been on the same scale, but prolonged heavy rainfall has seriously cut retail business along the coast. Electric ranges and water heaters are being featured in March and April by an industry-wide campaign in California. January, 1941, industrial employment average registered increases of 30 per cent in personnel and 50 per cent in payroll over January, 1940.

Privately financed building includes new Woolworth and Kress stores, averaging $300,000 each, for southern California; $350,000 for low rent housing in Bakersfield; new Pacific Coast headquarters and warehouses in San Francisco for J. A. Roeblings Sons Co.

Recent orders cover $100,000 G.E. special equipment for University of California cyclotron; $271,305 award for 51 miles 115-kv. steel tower line in Bonneville system; hardware and equipment for Southern California Edison switchyard extension, and $352,876 for Mare Island Navy yard distribution extensions. A new Colorado River power plant, 75 miles downstream from Boulder, is being considered for defense power and water control; $22,300,000 will probably be suggested for initial appropriation.

CHICAGO

Electrical business continues to move forward at a fast pace with all branches of the industry benefiting from the high level of general activity. The rapidly rising demand of electrical equipment for expanding industrial operations is building large backlogs for manufacturers. In addition, residential construction appears to be headed for a banner year as permits issued for the first two months are over 200 per cent ahead of last year.

Improving consumer purchasing power is reflected in the high demand for electrical household appliances. Sales of industrial and commercial lighting equipment are substantially above last year, with installation of fluorescent predominating. Public Service Co. of Northern Illinois is proceeding with construction work to supply 25,000 kw. to the new ammunition plants being built near Wilmington, Ill.

Defense orders placed here last week totaled $8,100,000, including electric equipment as follows: Circuit breakers, $18,477; X-ray apparatus, $42,831; generators, $22,000; switchboards, 31,594; telephone apparatus, $24,740; motor-generator sets, $32,223; transformers, $16,077; electric trucks, $9,383; portable drills, $31,017; cooking equipment, $91,141.

Metals
need vitamins, too!

● Much as vitamins fortify the body with greater vitality and resistance, minute and controlled amounts of substances added to metals and alloys greatly increase their efficiency, usefulness and life.

The research laboratories of Revere Copper and Brass Incorporated have made an intensive study of this metal "vitalizing" process. It has resulted in many improved applications of copper and its alloys. Three of these applications are especially notable.

1. A condenser tube notably resistant to "dezincification."

2. A sheet copper with a high resistance to "season cracking."

3. Brasses, bronzes and other alloys with finer "working" and "machining" qualities.

The Revere Technical Advisory Service is armed with much specialized knowledge of new developments in the copper family. Its services are available at no obligation for individual problems to which copper or copper base alloy may be the answer.

REVERE

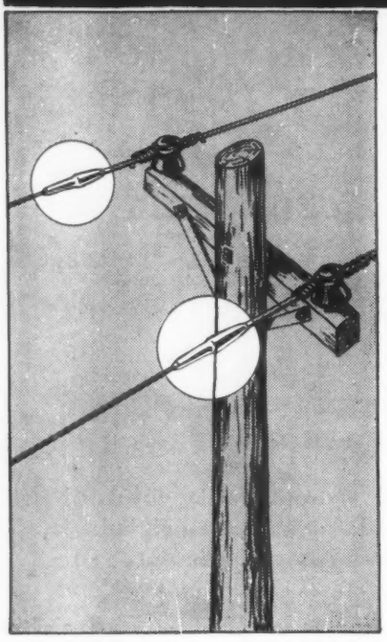
COPPER AND BRASS INCORPORATED

Executive Offices: 230 Park Avenue, New York, N. Y.

Sales offices and distributors in most of America's major cities

MILLS: BALTIMORE, MD. • TAUNTON, MASS. • ROME, N. Y.
NEW BEDFORD, MASS. • DETROIT, MICH. • CHICAGO, ILL.

modernize
YOUR
DISTRIBUTION
PRACTICE—



Urban construction where line drops portion of load and smaller wire size will carry current flowing through the rest of circuit.

RELIABLE
STRAIGHTLINE
REDUCERS . . . .

Save money and clean up appearance while eliminating a double dead-end. Sag of larger wire is only increased two or three inches as spans of city distribution are short.

Reliable
ELECTRIC COMPANY
OVER 30 YEARS SERVICE TO THE UTILITIES
3145 CARROLL AVENUE · CHICAGO ILLINOIS

Recent Legislation

Among the Utility bills which have been introduced in the various state legislatures are the following:

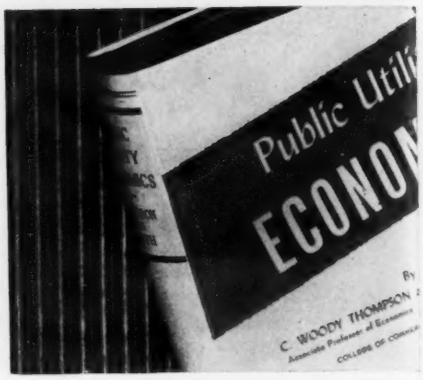
COLORADO—Measure introduced in the House by Representative A. Dean Coleman of Boulder would abolish the state public utilities commission and create a new department to take over the duties of that body. Other bills would impose a state franchise tax on public utilities and prohibit retail merchandising by public utility power companies.

MASSACHUSETTS—Lack of interest in bills scheduled for hearing before the committee on power and light recently brought a threat from committee members that in the future the measures may be reported adversely and "thrown out the window." One measure, which was expected to attract wide interest, would require electric companies to furnish light bulbs at one-half cost. The measure, which found no supporter, was opposed by Sheldon Wardwell of the Massachusetts Gas & Electric Association as unconstitutional. A measure seeking to require bills for use of gas and electricity to be so itemized as to show the quantity charged for at each rate received no support.

MINNESOTA—Pending before the Minnesota Legislature is a bill to outlaw purchase or sale to employees at wholesale prices of merchandise, not handled in the regular course of production or trade. A similar supplementary bill also proposes to prohibit state, county, city or township officials, acting as such, from buying goods at wholesale prices for officials or employees.

NEW MEXICO—Governor Miles has announced details of an administration-supported bill setting up a three-man commission for supervision and rate regulation of public utilities. The measure would give the new board power to pass upon all utility rate structures, mergers, franchises, security issues, other financial dealings and changes of service. The members of the commission would be appointed by the Governor.

NEW YORK—Governor Lehman has approved the Feinberg bill, authorizing the City of Plattsburgh, subject to the approval of the public service commission, to purchase properties of New York State Electric & Gas Corp. and provides for payment therefor from municipal electric plant construction fund. A political bombshell was thrown into the legislative hopper when Assemblyman Jerome C. Kreinheder of Buffalo introduced a bill amending the public authorities law to strike out the provision that the St. Lawrence River shall be used for development of commerce and navigation, the bill declaring that the interests of the people of the State of New York are opposed to its development as a navigable river or seaway and limits the authority to the development of hydro-electric power. The bill was referred to ways and means committee. An act was introduced in the Senate amending the tax law, in relation to clarifying and continuing for another year the emergency tax on gross incomes or gross operating incomes of corporations and persons furnishing utility services. A companion bill was introduced in the Assembly. A measure was introduced in the Senate amending the public service law, in relation to the regulation of the price of electricity and gas. The amendment read: "Every gas and electric



This book gives you a full and fresh appraisal of problems confronting public utilities today —

Drawing freely upon the literature of state commissions and state judicial systems, this book shows the place which public utilities occupy within our economic structure and the special problems of price control, service supervision, security regulation, etc., which the march of events since 1933 has brought about.

Just Published

PUBLIC UTILITY ECONOMICS

By **C. Woody Thompson**
Associate Professor of Economics
and Wendell R. Smith
Instructor in Commerce
State University of Iowa

726 pages, 6x9, illustrated. $4.50

The book reflects the latest developments in the field, shown by the elevation of the holding company problem to the status of a primary problem of regulation, and the emphasis given to recent problems such as the decline of the street railway, utility service in rural communities, and two chapters on public power projects.

Answering your questions on:

Public Utility Organization and Finance
Techniques of Regulation
The Problem of Reasonable Rates
Rate Making Theory and Practice
The Marketing of Utility Service
The Tennessee Valley Authority
The Problem of Security Regulation

10 DAYS' TRIAL—SEND COUPON

McGraw-Hill Book Co., 330 W. 42nd St., N. Y. C.
Send me Thompson and Smith—Public Utility Economics for 10 days' examination on approval. In 10 days I will send $4.50 plus few cents postage, or return book postpaid. (We pay postage on orders accompanied by remittance.)

Name .....
Address .....
City and State .....
Position .....
Company .....W. 3-8-41
(Books sent on approval in U.S. and Canada only.)

DELIVERIES—
NOT PROMISES!

LOW COST CLIPON AMMETER

LIST $80.

..Perfect Balance
..Light Weight
..Completely Insulated Jaws
..±2% Accuracy

ALSO MULTI RANGE CLIPON AMMETER 0-10/25/100/250/1000 AMPS. LIST $120.

DUAL RANGE 0-100/500 AMPS

..Large 2¼" Square Opening
..Long Open Scale
..50 Scale Divisions
..10 Years' Proven Service

PHASE ROTATION INDICATOR

..Instant Indication of Phase Rotation
..110/550 Volts
..2½" Portable Pocket Model

LOW COST

..Complete with Heavy Insulated Leads
..Heavy Clips with Rubber Guards
..Also Flush and Surface Types

LIGHT WEIGHT

LIST $60.

NEW HIGH ACCURACY PORTABLE VOLTMETER

LIST $66.

..0–150/300/750 Volts
..Long 5¼" Scale
..½ of 1% Accuracy
..AC-DC
..Hand Calibrated Mirror Scale
..150 Scale Divisions

..Frequency 15–135 cps.
..Hinged Cover with Leather Carrying Handle
..Light Weight—Robust Construction
..Conforms to A.I.E.E. and N.E.M.A. Specifications

MADE IN U.S.A.

NO DELAY

All Instruments Available Immediately from Stock

We can also give *immediate* deliveries on your requirements for Special Transformers, etc., etc.

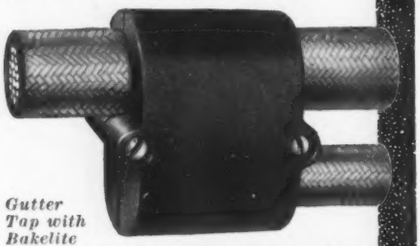
FERRANTI ELECTRIC, INC. 30 Rockefeller Plaza New York, N.Y.

Ferranti Electric, Ltd., Toronto, Canada • Ferranti, Ltd., Hollinwood, England

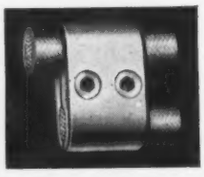
The MOST COMPLETE
LINE OF
Cable Taps

Parallel and 90° taps—and combinations—for the widest variety of applications. For conductor sizes up to 1,000,000 CM.

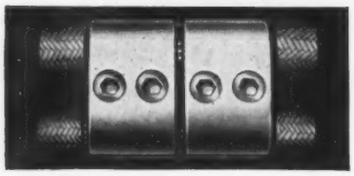
Now you can select from a really *complete* line of standard and special taps. Carefully designed—made right—and giving excellent service to all classes of users.



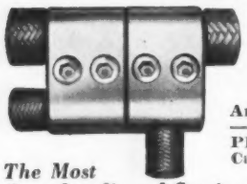
Gutter Tap with Bakelite Cover. Insulating covers can be furnished for all types of Penn-Union Cable Taps.



2-Way Gutter Tap; main and branch sizes 8 to 1,000,000.



Two Separate Parallel Taps to a continuous main conductor.



Combination Cable Tap; one branch tap parallel to main, and one at 90°.

And many more—write for the PENN - UNION Catalog.

The Most Complete line of Service Connectors—Terminals—and thousands of other fittings, for all requirements.

Penn-Union is the choice of leading utilities, "industrials," and manufacturers of electrical equipment.

Sold by Leading Jobbers

PENN-UNION ELECTRIC CORPORATION
ERIE, PA.

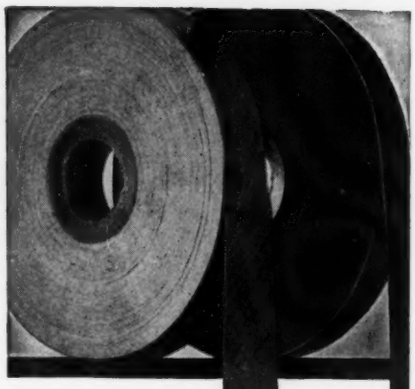
PENN-UNION
Conductor Fittings

corporation whose filed schedules contain optional rates shall within thirty days after the first day of September, 1941, and annually thereafter, give written notice to each consumer entitled under said filed schedules to an optional rate or charge of the lowest rate or form of rate available in its filed schedules for the class and quantity of service rendered, based on the use thereof of said consumer in the preceding twelve-month period and shall make such lowest rate or form of rate available to the future service of said consumer." A companion bill was introduced in the Assembly.

OREGON—Payment of inspection fees by all companies operating power, telephone or transmission lines in Oregon is provided in a bill introduced in the Senate.

WASHINGTON — Bills incorporating changes requested by the Department of Public Service have been introduced by Representative Jurie B. Smith. One measure would require public service companies to pay for any investigation made by the department into the accounts or activities of the company. The present law requires the utilities to pay only that amount which the investigation costs, in excess of the regulatory fees paid by the company. Another bill would provide that the department may suspend any proposed rate change by a public service company for 18 months. At present a rate change can be suspended only seven months. Mr. Smith's other bills would regulate sale of properties by public service companies and prohibit certain payments by them to affiliated interests. Legislation taxing public utility districts 2 per cent of their gross revenue from the sale of electric energy has been introduced in the Legislature. The tax would be collected by the state treasurer and allocated to county treasurers in proportion to the amount of operating property in the county, should the utility district cover more than one county.

WISCONSIN—A bill to modify the license fee of rural electric co-operative associations in Wisconsin has been introduced in the Assembly. The 1939 legislature enacted a law providing for a 3 per cent license fee on the gross income of electric co-operatives in lieu of all income and property taxes. The current bill changes the fee to a 3 per cent tax on the gross sale of electric energy in lieu of all other taxes. The bill, it was explained by its authors, would correct an unforeseen eventuality in enactment of the 1939 law under which co-operatives are being taxed for repayments by members of loans made for purchase of equipment, appliances and wiring. The measure also provides that the first license shall be based on gross sales of electric energy for the year 1939. The Beggs bill, which provides that all service deposits of consumers of electric, gas, water and other utilities revert to the state if unclaimed for 10 years, has been introduced in the Assembly. The cash deposits would revert to the state under the laws of escheat similar to the present reversion of unclaimed bank deposits. A bill to restore state sponsorship of the Wisconsin Development Authority has been introduced in the Assembly by Andrew J. Biemiller, Milwaukee, and Arthur L. Padrutt, Chippewa Falls. The measure would appropriate $10,000 immediately and $60,000 annually starting July "for the promotion, encouragement, organization or creation of municipal power districts." A bill was introduced in the Senate providing that municipal electric and water plants could not be



for extra
STRENGTH
STRETCH
and DIELECTRIC SAFETY—

Acme BIAS TAPES

Acme bias tapes exceed all N.E.M.A. requirements for tensile and dielectric strength. With plenty of stretch, they fit snugly into difficult spaces, and when the job is done, it is electrically safe. For all-around satisfaction, specify "Acme"!

THE ACME WIRE CO., NEW HAVEN, CT.

ACME WIRE PRODUCTS
VARNISHED INSULATIONS
MAGNET WIRE COILS

DELTA-STAR
Bus & Cable Connectors
ASK FOR BULLETIN 38-D

TYPE "TU"
Solderless Connectors

High compression type. One piece yoke with DURONZE U-bolts. Both connector and yoke are cast with longitudinal waves, deforming conductors to insure high pull-out strength.

A design for those desiring the utmost in electrical connectors, symmetry and appearance.

DELTA-STAR ELECTRIC CO.
2400 BLOCK FULTON ST.
CHICAGO, ILLINOIS.

forced to extend service outside the corporate limits of the municipality. Another measure introduced in the Assembly at the request of the League of Wisconsin Municipalities would limit powers of the state public service commission in reducing rates of municipally-owned electric utilities. The bill forbids the commission to begin rate reduction proceedings except on complaint of the governing body of the municipality, on complaint of 25 per cent of the utility's customers or on complaint of the utility commission in charge of the local utility.

WYOMING—Two attempts have been defeated in the Legislature to pass a bill permitting municipalities to issue revenue bonds for financing the purchase of privately owned light, power, gas and water systems in the state. This bill in its original form would have made it possible for municipalities to proceed with the purchase of utility systems after having secured approval of the municipal officials, and without referring the matter to a full vote. The original bill, HB-4, introduced by Cheyenne's democratic representative, John D. Clarke, was killed on the third reading by a vote of 19-35. Attempt to rejuvenate bill by amendment was immediately attempted by Clarke. The amendment, which made an entirely new bill of the original measure, placed authority to issue revenue bonds in the hands of the municipalities already authorized by law to undertake the operation of public utilities. Both the bill and the amendment were rejected by a vote of 16-32 when recommended to the house acting as a Committee of the Whole. Following failure of a "Do Pass" motion for the amended bill it was indefinitely postponed.

•

Recent Rate Changes

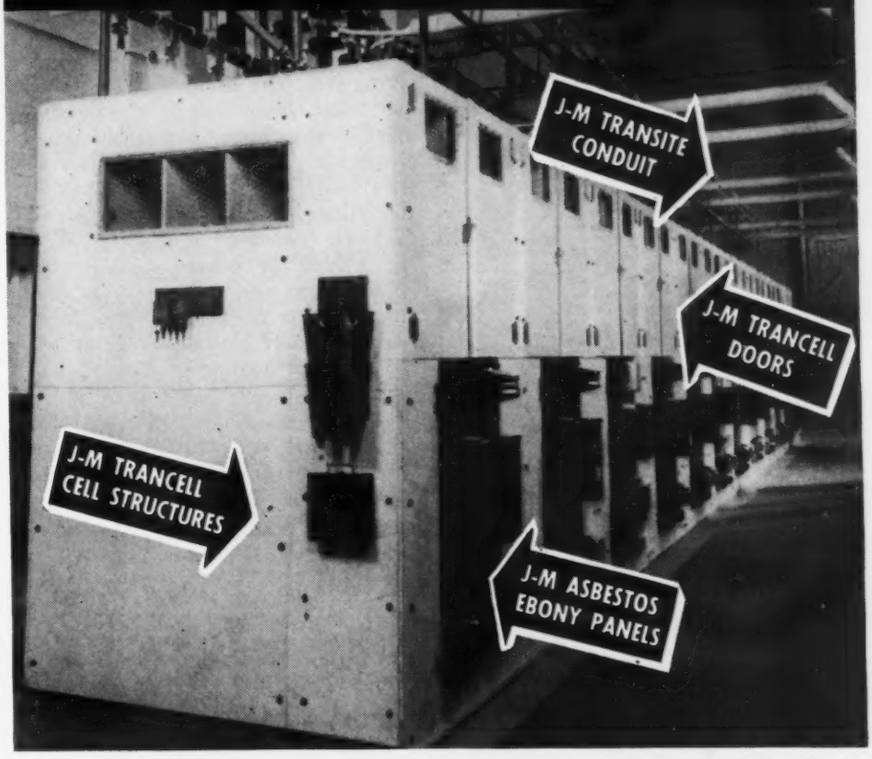
PENNSYLVANIA PUBLIC UTILITY COMMISSION, as a result of negotiations concluded in 1940, secured rate reductions totaling $5,931,075 for utility customers. Of this total annual saving, $3,620,962 was made available to customers in 1940; the remainder in 1941. The biggest saving was made on electric bills. It amounted to $5,576,577. Twenty-five electric companies, five gas companies, eight water companies, seven telephone companies and two bridge companies participated in these reductions.

LEWISBURG LIGHT & POWER DEPARTMENT, Lewisburg, Tenn., will eliminate the surcharge of 10 per cent which has been collected from commercial and industrial users of electricity since the city began using TVA power. The reduction will be a saving of approximately $10,000 during the next year, based on the amount collected during 1940.

MARSHFIELD ELECTRIC AND WATER DEPARTMENT'S rate revision, which changes the old transformer charge type of billing to a standardized rural residential and commercial rate, has been approved by the Wisconsin Public Service Commission. The rate is expected to save consumers $1,640 annually on rural residential and farm charges and about $2,000 annually on commercial bills.

ARKANSAS PUBLIC UTILITIES DEPARTMENT authorized in 1940 rate reductions to the amount of $774,932, not including a $500,000 Arkansas Louisiana Gas Co. refund, according to the annual report issued recently. Electric reductions amounted to $192,728.

MONEY-SAVING MATERIALS for STATION MODERNIZATION



With these four Johns-Manville materials, you are assured of incombustible, long-lasting, virtually maintenance-free housings and ducts

J-M Trancell Cell Structures—This fireproof asbestos sheet confines oil fires to cells in which they originate. Reduces condensation trouble and, being rustproof, never causes shutdowns for cleaning or painting. Rapidly and economically erected, Trancell's light weight permits housing of equipment in multi-storied buildings without overloading of floors.

J-M Trancell Doors—Asbestos-cement facings over a mineral core, Trancell Doors are fireproof, light in weight, unusually strong and highly resistant to shock. Multiple-layer construction assures minimum warpage. Easily cut, sawed, and drilled; quickly installed by any handyman. A complete line of hardware is available.

J-M Transite Conduit—This asbestos-cement duct is strong, incombustible, unusually corrosion-resistant. Requires no protective casing either exposed or underground. Transite *Korduct*, thinner walled, is used on concreted-in jobs.

J-M Asbestos Ebony—Used for switchboard panels, bus-bar supports, switch bases, etc., Asbestos Ebony maintains its high dielectric strength and insulation resistance in service. Withstands shocks and vibration; unaffected by temperature variations; and won't warp or crack.

• • •

For complete details on these durable, dependable J-M Materials, ask for Catalog D. S. 400. Johns-Manville, 22 East 40th Street, New York, N. Y.

JM

Johns-Manville ELECTRICAL PRODUCTS for lower electrical-distribution costs

ELECTROMAGNETIC . . . DEVICES

Learn how they operate and why . . .

This book presents complete and modern data on theory and design

Published February 1941

By

HERBERT C. ROTERS

Director of Research, Fairchild Aviation Corp. Formerly Assistant Professor of Electrical Engineering, Stevens Institute of Technology

ELECTROMAGNETIC DEVICES, in Chapters I through VIII, presents the fundamental principles and discusses the methods applicable to all types of magnetic circuits and nonrotary electromagnetic devices. The remaining six chapters cover the practical application of the theory to the solution of diverse problems. The general treatment of these solutions is followed by examples of exact and specific numerical solutions.

These and other topics are included: Unusually complete data on magnetic materials, detailed development of all types of magnetic circuit calculations, magnetic force formulas, transients in magnets, electrodynamic problems, shading coils for A-C magnets, use of new magnetic materials for relays.

561 pages **267 illustrations**
6 by 9 **$6.00**

ON APPROVAL COUPON

John Wiley & Sons, Inc.
440 Fourth Ave., New York, N. Y.

Kindly send me, on ten days' approval, a copy of **Roters' Electromagnetic Devices.** At the end of that time, if I decide to keep the book I will remit $6.00 plus postage; otherwise, I will return it postpaid.

Name .....

Address .....

City and State.....

Employed by.....

EW-3-8-41

Twelve Systems Get $500,000 from REA

Allotments, totaling $500,000 were recently announced by Harry Slattery, Administrator of Rural Electrification, for rural electrification in seven states.

These allotments provide for the establishment of one new power system; for purchase of local poles by three "self-help" systems in the State of Minnesota, two of which, due to lack of funds, have had no allotments as yet for distribution lines, and the enlargement of three co-operatives and two public power districts. In addition, the allotments provide for member connections for two borrowers, for the completion of construction of office building, garage, and storeroom facilities for one co-operative and for the purchase and alteration of an office building for another.

This brings allotments made by REA since it was established in 1935 to $361,107,121, of which $91,733,000 represents operations of the current fiscal year. Details follow:

GEORGIA—Oconee Electric Membership Corp., Dudley, George C. Ingram, supt., $50,000 to build 62 miles of line, 220 members in Wilkinson, Laurens, Twiggs and Bleckley counties.

ILLINOIS—Illinois Valley Electric Co-operative, Inc., Princeton, John H. Wolfe, supt., $70,000 for member connections. Norris Electric Co-operative, Newton, Merle D. Yost, supt., $105,000 to complete construction of second section of system.

MINNESOTA—North Itasca Electric Co-operative, Inc., Bigford, Martin Nesseth, president, $25,000 to permit right-of-way clearing to proceed and provide funds with which to purchase local poles.

NEBRASKA—Southeastern Nebraska Public Power District, Beatrice, Paul D. Marvin, manager, $65,000 to build 68 miles of line, 152 members in Gage, Jefferson, Lancaster and Pawnee counties.

PENNSYLVANIA—Bedford Rural Electric Co-operative, Bedford, Walter W. Messerall, supt., $27,000 to build 45.5 miles of line, 100 members in Bedford, Somerset and Fulton counties.

UTAH—Moon Lake Electric Association, Inc., Mt. Emmons, Ed D. Conklin, supt., $6,000 for purchase and alteration of office building and for member service extensions.

WASHINGTON—Chelan County Electric Co-operative, Inc., Leavenworth, Floyd E. Morrow, president, $52,000 to build 43 miles of line, 226 members in Chelan county.

Among the construction contracts recently approved are the following:

ALABAMA—Black Warrior Electric Membership Corp., Demopolis, Frank L. Holman, supt., and Gordon Persons & Co., Inc., 200½ Montgomery St., Montgomery, Ala., engineer, contract to W. L. Coston and Sons, Bessemer, 458 miles of line, 848 members; bid, $223,571.

GEORGIA—Habersham Electric Membership Corp., Clarkesville, E. A. Lunceford, supt., and J. B. McCrary Engineering Corp., Atlanta, engineer, contract to Day & Zimmermann, Inc., 620 Packard Bldg., Philadelphia, Pa., 176.6 miles of line, 489 members; bid, $108,138.

Crapo
GALVANIZED STEEL
STRAND

STRENGTH, ruggedness and durability are combined with definite economy in *Crapo* Galvanized Steel Strand. Low first cost, low maintenance expense are matters of record wherever this time-tested product is in use. Available in all standard grades and sizes from representative jobbers throughout the country. Or, write—

INDIANA STEEL & WIRE CO.
MUNCIE, : : INDIANA

3 TIMES THE SERVICE

WHEN YOU USE
TRICO *Powder-Packed* FUSES and KLIPLOK CLAMPS

This famous TRICO COMBINATION is saving users thousands of dollars annually thru the elimination of unnecessary shutdowns caused by faulty fuses and bad clips.

For safe, efficient and dependable service INSTALL TRICO TODAY.
Write for Bulletins No. 1 & 6.

TRICO FUSE MFG. CO., Milwaukee, Wis.
In Canada: IRVING SMITH LIMITED, Montreal

FLORIDA—Lee County Electric Co-operative, Inc., Fort Myers, Homer T. Welch, Jr., supt., and E. P. McLean Engineering Co., 222 Commercial Building, Moultrie, Ga., engineer, contract to W. A. Smith, 225 Heyburn Bldg., Louisville, Ky., 87.5 miles of line, 306 members; bid, $73,121.

ILLINOIS—Menard Electric Co-operative, Petersburg, A. E. Becker, supt., and Stanley Engineering Co., Muscatine, engineer, contract to the White City Electric Co., 569 W. Van Buren St., Chicago, 226.2 miles of line, 485 members; bid, $185,306.

INDIANA—Knox County REMC, Vincennes, M. J. Westfall, supt., and Laramore and Douglass, Inc., 327 South LaSalle St., Chicago, Ill., engineer, contract to C. A. Hooper Co., Madison, Wis., 181.4 miles of line, 551 members; bid, $115,713.

KANSAS—Sumner-Cowley Electric Co-operative Assn., Inc., Wellington, C. L. Weber, supt., and C. H. Guernsey & Co., 1216 South Grand Ave., Cherokee, Okla., engineer, contract to Humphreys and Thomson, 204 NW 33d St., Oklahoma City, Okla., 361.4 mile of line, 540 members; bid, $189,857.

KENTUCKY—Blue-Grass Rural Electric Co-operative Corp., Nicholasville, Ky., Phil R. Holloway, supt., and Ray W. Chanaberry, Inc., Louisville, Ky., engineer, contract to Shely Construction Co., 809 Manchester St., Lexington, Ky., 35 miles of line, 90 members; bid, $22,933.

LOUISIANA—Beauregard Electric Co-operative, Inc., DeRidder, La., Richard I. Davis, supt., and H. B. Gieb & Co., 1109 Mercantile Bldg., Dallas, Tex., engineer, contract to L. O. Brayton & Co., Dyersburg, Tenn., 117 miles of line, 243 members; bid, $59,671.

MINNESOTA—Tri-County Electric Co-operative, Rushbord, Minn., Earl J. Kjos, supt., and Bannister Engineering Co., 1586 University Av., St. Paul, Minn., engineer, contract to Bigham and Dresser, 312 Exchange Bldg., Winona, Minn., 270.4 miles of line, 527 members, bid, $151,981.

MISSISSIPPI—Twin County Electric Power Assn., Hollandale, Miss., E. G. Neely, supt., and Bowman and Bowman, Greenwood, engineer, contract to the Oman Construction Co., Nashville, Tenn., 159 miles of line, 583 members; bid, $75,719.

MISSOURI—Ozark Border Electric Co-operative, Poplar Bluff, A. I. Moore, supt., and Rural Line Engineers, Central Bldg., Clayton, Mo., engineer, contract to E. A. Reither, Aitkin, Minn., 516.6 miles of line, 1,175 members; bid, $318,363.

NORTH CAROLINA—Brunswick Electric Membership Corp., Shallotte, N. C., Edson D. Bishop, supt., and B. O. Vannort, 1207 Commercial Bank Bldg., Charlotte, N. C., engineer, contract to Little Electric Co., Union, S. C., 120.9 miles of line, 505 members; bid, $88,576.

OREGON—Wasco Electric Co-operative, Inc., The Dalles, Ore., Eric A. Johnson, supt., and P. L. Adkins, Port Docks Bldg., The Dalles, Ore., engineer, contract to Newport Construction, 7,031 N.E. Halsey St., Portland, Ore., 264 miles of line, 342 members; bid, $198,289.

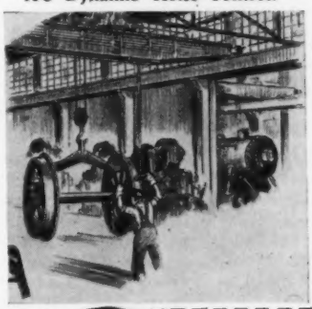
SOUTH CAROLINA—Broad River Electric Co-operative, Inc., Gaffney, S. C., G. G. Inman, supt., and J. B. McCrary Engineering Corp., 1,408 Marietta St. Bldg., Atlanta, Ga., engineer, contract to Wheatley and Mobley, 718 Reynolds St., Augusta, Ga., 289.6 miles of line, 891 members; bid. $177,738.

TENNESSEE—Fort Loudon Electric Co-operative, Madisonville, J. F. Llewellyn, president, and J. B. McCrary Engineering Corp., 1408 Marietta St. Bldg., Atlanta, Ga., engineer, contract to Forcum-James Co., Dyersburg, Tenn., 250.8 miles of line, 800 members; bid, $168,609.

IN the past, D-c Control Equipment for Cranes stood head and shoulders above A-c. Plants frequently went to the expense of purchasing motor-generator sets to get the better performance of a D-c installation.

Now—this has been completely changed. The economies of using available A-c power can still be had without a great sacrifice in accuracy and low up-keep cost. The new EC&M all A-c Magnetic Control gives results previously impossible to obtain on A-c cranes—elimination of the mechanical load-brake; extreme accuracy in inching; and smooth operation without danger of overspeeding.

Handling locomotive wheels in a railroad machine shop with EC&M A-c Dynamic Hoist Control.



Many installations of this new all A-c Control are now in service on overhead, whirler, boom and bridge cranes. There may be one in your vicinity which you can inspect. Write us. The Electric Controller & Mfg. Co., Cleveland, Ohio.

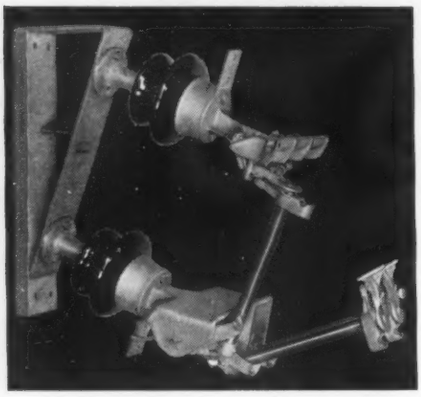
Please send A-c Crane Folder 930-A

NAME_____

ADDRESS_____

MOTOR CONTROLS • BRAKES • LIMIT STOPS • MAGNETS

RECLOSING FUSES WERE PIONEERED BY SOUTHERN STATES



How Much Revenue Can You Gain By Eliminating 64% Of Your Service Interruptions?

One Southern power company *did* eliminate 64.6% of its interruptions. *Actual* figures compiled by this large utility over a period of 9 years included 212 units of Southern States reclosing fuses. These figures show that 64.6% of would-be interruptions on this company's important feeders were eliminated.

Analysis of the tabulated figures reveals that 47.4% of the restorations were made by the first reserve cartridge, 17.2% by the second. Interruptions of permanent nature due to lines and poles being down, transformers failing, etc., account for the remaining 35.4%.

Over the entire 9-year period, operation of the 212 units of Southern States reclosing fuses was 93.5% perfect. Many of the units included in these figures are some of the first reclosing fuses ever built which are still in service, maintaining service.

Southern States reclosing fuses are positive in action. They will eliminate tedious patrols, keep meters turning, and customers will be pleased with the continuity of service. Furthermore, Southern States reclosing fuses give your costly equipment ample protection from overloads, lightning and surges.

Investigate Southern States reclosing fuses further by talking with your Southern States representative. Or write for complete Southern States reclosing fuse information which is contained in Bulletin R-155 now ready for you. Your card or letter will receive prompt attention.

Write for Bulletin R-155 Now

Southern States Equipment Corporation

28 S. 20th St. Birmingham, Ala.

Canadian Representative:
Dominion Cutout Co., Ltd., Toronto

Sales Opportunities

NORTH PLATTE, NEB. — City Council plans expansion and improvements in municipal power plant, including installation of equipment for increased capacity. Also will carry out extensions in electrical distribution system. Cost estimated close to $150,000. Proposed to carry out work in spring.

CALUMET, LA.—United States Engineer Office, New Orleans District, foot of Prytania Street, New Orleans, La., receives bids until March 24 for design and construction of steel towers, and 33-kv. power line and accessories, over Wax Lake outlet, South of Bayou Teche, near Calumet, St. Mary Parish (Circular 338).

KENOSHA, WIS.—American Brass Co., Waterbury, Conn., plans installation of motors and controls, transformers and accessories, duct lines, exterior and interior lighting systems, switchgear, inter-communication system, electric hoists, conveyors and other equipment in new plant near Kenosha, for production of ammunition brass cups and allied products for War Department. A steam power house will be built. Plant will comprise several large one-story units and is estimated to cost about $4,750,000, in which amount appropriation will be provided by Government.

MARYSVILLE, MICH.—Detroit Edison Co., Detroit, has approved plans for addition to steam-electric generating station at Marysville, for expansion in electric and steam divisions, and will award contract soon for erection of superstructure.

WILLIAMSBURG, VA.—Virginia Electric & Power Co., Richmond, Va., plans extensions in transmission lines in vicinity of Williamsburg and Yorktown. Also will carry out expansion in electrical distributing systems in these municipalities and made additions to power substations, with installation of transformers, switchgear and auxiliary equipment for larger capacity. Cost reported close to $170,000.

WASHINGTON, D. C.—Bureau of Yards and Docks, Navy Department, Washington, receives bids (no closing date stated) for one 6000-kw. and one 4000-kw. turbine-alternator units, each with condenser, pumps and accessory equipment, for installation at navy yard, Washington, and at naval operating base, Norfolk, Va. (Specifications 10335).

LAFAYETTE, LA.—City Council plans expansion in municipal power plant, including installation of new generating unit and auxiliaries. Bids for equipment will be asked at early date.

CORVALLIS, ORE.—Administrator, Bonneville Project, Department of Interior, Portland, Ore., plans new 66-kv. transmission line for service at Corvallis, Newport, Waldport and vicinity. It will be about 60 miles long. Surveys will be placed under way at once. Also, has authorized surveys and acquisition of right-of-way for new transmission line from power substation at Eugene, Ore., to Drain, Ore., and vicinity, about 42 miles, where terminal substation will be located for distribution for rural service in parts of Lane and north Douglas Counties.

BEAVER, PA.—Curtiss-Wright Corp., Propeller Division, 30 Rockefeller Plaza, New York, N. Y., plans installation of motors and controls, transformers and accessories, switchgear, exterior and interior industrial lighting facilities, duct lines, inter-communication system, electric hoists, conveyors and other equipment in new plant at Beaver, near Pittsburgh, where large tract of land has been secured. It will consist of a group of one-story structures for large capacity for Government. A steam power house is planned. Entire project will represent an investment of about $5,221,000, and fund in that amount will be secured through War Department. Work will begin early in summer. It is understood that plans will be drawn by Albert Kahn Associated Architects & Engineers, Inc., New Center Building, Detroit, Mich., architect and engineer.

MEMPHIS, TENN.—United States Engineer Office, Memphis, receives bids until April 10 for complete electrical equipment for Nonconnah and Cypress Creek pumping stations, as per plans and specifications on file.

LAS ANIMAS, COLO.—City Council has plans maturing for new municipal power plant, for which a bond issue of $275,000 recently was authorized. E. T. Archer & Co., New England Building, Kansas City, Mo., are consulting engineers.

WAYNESVILLE, MO. — Citizens Electric Co. of Missouri, Waynesville, plans extensions in transmission line. Application for permission has been made. Work will be carried out in spring.

PORTSMOUTH, VA.—Public Works Office, Norfolk Navy Yard, Portsmouth, receives bids (no closing date stated) for one 10,000 cubic-foot per minute capacity, synchronous motor-driven air compressor, with inter-coolers and after-cooler, motor-generator exciter set, motor-operated exciter field rheostat and auxiliary equipment for installation at Norfolk yard (Specifications 10313).

PORTLAND, ORE.—Oregon Shipbuilding Co., Lewis Building, Portland, plans installation of heavy-duty motors and controls, air compressors, transformers and accessories, switchgear, duct lines, exterior lighting facilities and industrial lighting system for shops, electric hoists and cranes, conveyors and other equipment in new shipbuilding plant at local port, in vicinity of Terminal No. 4. It will consist of eight shipways, outfitting docks, shops and other structures, with power substation facilities for central station service. New yard will be used for construction of vessels for United States Maritime Commission, Washington, D. C., and is estimated to cost $4,780,000. Appropriation in that amount will be secured through Government.

DOVER, OHIO—Department of Public Service, Harry Stukey, director, plans expansion and improvements in municipal power plant, including installation of equipment for increased capacity. Estimates of cost will be made at early date.

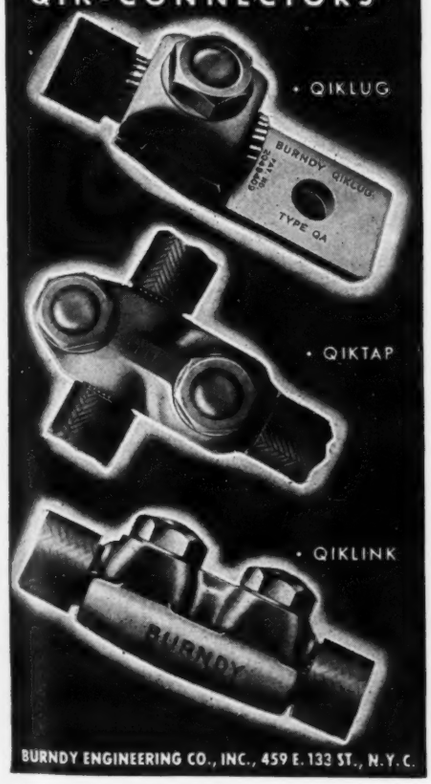
WENDOVER, UTAH—United States Engineer Office, 751 South Figueroa Street, Los Angeles, Calif., receives bids (no closing date stated) for three 150-kw. diesel engine-driven generating units and auxiliary equipment for installation at Wendover.

EVERSTICK ANCHORS...

Provide dependable anchoring when poles are subjected to unusual strains from storms. Made of tough, certified, rust resistant, malleable iron for extra strength and holding power. Write for new bulletin.

EVERSTICK ANCHOR CO.
FAIRFIELD, IOWA

BURNDY
QIK-CONNECTORS



BURNDY ENGINEERING CO., INC., 459 E. 133 ST., N.Y.C.

Electrical Features of Claytor Hydro Plant

[*Continued from page 59*]

the 132-kv. switching station on the south abutment some 360 ft. above the elevation of the turbine room floor. The natural topography was changed as little as possible and the required grading held to a minimum. Hence, although most of the site had to be cut out of the dolomitic rock and that increased excavation costs, it did bring about a reduction in steel costs. Advantage was also taken of the natural topography by landscaping the areas between natural rock groups with suitable grass plots resulting in the least disturbance to the natural beauty of the surrounding landscape and in one of the best appearing substations on the American Gas & Electric Company system.

The fact that, based on long, favorable experience, the operation of the 132-kv. yard was going to be automatized in any event solved the operating problem for routine operating processes. However, supplementary electrical control of switching equipment was provided at the power house switchboard. This location of control equipment permits, if desired, full supervision and manual control by the plant operator of the oil circuit breakers in the switching station.

For access to the switchyard, facilities were provided in the form of an inclined electrically operated tramway.

Transformer Banks

Two transformer banks, each having a continuous capacity of 43,500 kva., but capable of carrying 50,000 kva. when river conditions warrant, were installed on the transformer deck of the power house, and these connect the output of the generators to the 132-kv. transmission system.

The seven single-phase, 132/11-kv., 14,500-kva. transformers installed consist of six units of the conventional oil-insulated, forced air-cooled type and a seventh unit embodying a new design using "Pyranol" as an insulating medium instead of oil and resorting to positive forced circulation and a separate air-cooled radiator system for cooling the "Pyranol." Factory tests indicate that this unit will be at least as efficient as the six conventional units installed. The real economy of the new forced cir-

Engineers of many large Operating Companies now Specify

DURAPOLE
WESTERN RED CEDAR
The pole with extended service life above the ground

ADDED QUALITY
FOR BETTER PERFORMANCE

The DURAPOLE, with its many improvements and its greater durability in the above ground section, offers users a new high in power line supporting structure quality. From butt to pole top you will find the DURAPOLE an outstanding value. Make that next order read DURAPOLE whether for poles to be used for replacement or a complete new line. You will find out, after your men handle DURAPOLES, after you store them, and after they are erected, why it pays to standardize on DURAPOLE with its many features (see below).

These are the benefits that make
DURAPOLE
today's cost-saving purchase

SLAB GAINED — for perfect drainage — for secure arming — for much better appearance.

FULL LENGTH TREATED — for sterilization of sapwood — for uniform light brown permanent color — for attractive appearance.

MACHINE SHAVED — for increasing the life of the pole above ground — for improved appearance.

Butt treated ½" guaranteed penetration —no reduction of sapwood in butt section.

VALENTINE CLARK CORPORATION
2516 DOSWELL AVE., ST. PAUL, MINN.
Dwight Building, Kansas City, Mo.
84 William St., New York City

ELECTRITE
A high grade fibre board for electrical insulation. A material of quality possessing high tensile and dielectric strength. Used by many of the leading manufacturers of electrical equipment.

DENSITE
An extremely hard board of superior quality which can replace the more expensive types of insulating materials.

Pulp Products Department
WEST VIRGINIA PULP & PAPER COMPANY
230 Park Avenue, New York, N.Y. 35 E. Wacker Drive, Chicago, Ill.

"IMPROVED METAL SNATCH"
Another
"ANVIL BRAND" BLOCK
In Favor With Linesmen

SEND FOR CATALOGUE
COMPLETE LINE TO
WESTERN BLOCK CO.
Market Street
Lockport, N. Y.
NEW YORK CITY
74 Murray St.
CHICAGO
34 N. Clinton St.

HIGH GRADE
HARD PORCELAIN
FOR
Electrical Specialties
High and Low Voltages

IMPERIAL
PORCELAIN WORKS
TRENTON, NEW JERSEY

How to make better use of mathematics in solving engineering problems—

This book presents an introduction to more advanced mathematics of unusual value to engineers in the civil, mechanical, aeronautical and electrical fields. It simultaneously presents mathematics and examples of applications in fundamental engineering problems, in a treatment especially calculated to make mathematics more usable—to give the reader the conceptions necessary to set-up and complete effective equations for definite problems.

Just Out!

MATHEMATICAL METHODS IN ENGINEERING

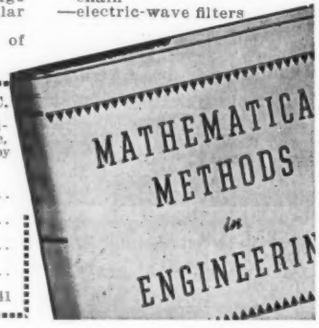
By T. V. KÁRMÁN
Director of the Guggenheim Aeronautics Laboratory, California Institute of Technology
and MAURICE A. BIOT
Assistant Professor of Mechanics, Columbia University

505 pages, 6 x 9, illustrated, $4.00

A few of the topics covered

—Solution of the frequency equation and calculation of the normal modes by use of matrices
—dissipative systems. The analogy between mechanical and electrical oscillations
—rules for the calculations of the impedance of electrical and mechanical systems
—response of an electric network to the sudden application of a constant voltage
—buckling of a rectangular lattice truss
—voltage drop in a chain of electric insulators
—critical speeds of a multi-cylinder engine
—waves in a mechanical chain
—electric-wave filters

McGraw-Hill Book Co., Inc., 330 West 42nd St., N. Y. C.
Send me Karman and Biot—Mathematical Methods for 10 days' examination on approval. In 10 days I will send $4.00 plus few cents postage, or return book postpaid. (We pay postage on orders accompanied by remittance.)
Name .....
Address .....
City and State .....
Position .....
Company W-3-8-41



culation unit comes in the savings that it makes possible in space, dimensions, weight and structural requirements of the supporting structure. Located in line with the power transformers are two 1,500-kva., three-phase, 11-kv./460-volt transformers which provide auxiliary power for operation of the development. As previously mentioned, servicing of the transformers will be done in the power house and permanent trackage facilities were provided between the transformer platform over the power house and the generator room.

Fire protection for the transformers has been provided by means of a "Mulsifyre" system, consisting of a number of sprinkler heads located around each transformer. These sprinkler heads are so designed that a stream of water is broken up until it becomes a very fine, almost fog-like spray. When this spray under the proper pressure is injected into burning oil the water coats the globules of oil into which the oil layer is broken with a thin film, forming an emulsion which does not permit sustained combustion. This system is controlled through heat sensitive control devices located at various points around each transformer which actuate relays to start up a fire pump and furnish water from reservoir to the "Mulsifyre" system. A series of alarms is also connected into the thermostat-actuated circuits so that the operator will be immediately warned when the "Mulsifyre" system goes into operation.

Oil-Handling System

An oil-handling system is installed for the servicing of transformer and oil circuit breaker insulating oil. The purifier, filter press and pumps, etc., are housed in a building located on the quarry bench immediately south of the power house. The 7,500-gal. storage tanks are located adjacent to the oil house for storage of transformer and oil circuit breaker oil. Two of the tanks are used for storing clean oil, one containing a reserve supply of transformer oil, the other a reserve supply of oil circuit breaker oil and the third tank is used for storing dirty oil of either type whenever it is necessary to change the oil in a piece of equipment. To facilitate changing oil in the equipment located in the substation on the hill

two 3-in. steel pipes and pumping equipment were installed and connected between the substation and oil house.

[An ensuing article will treat the bus and protective arrangements in the station.]

Pattern of Station Auxiliary Drives Is Changing

[Continued from page 66]

and standby sources of auxiliary power in the stations covered by Tables I and II. The corresponding data from the 1930 N.E.L.A. survey[1] are given for comparison.

One may conclude from Table III that the low cost, simplicity and dependability of transformer supply are judged by most operators to outweigh the freedom from system disturbances that can be obtained by having a separate auxiliary generator. Some saving in cost can be effected by connecting the transformers to generator leads instead of to the station bus, but the sacrifice in flexibility is generally believed to more than offset the saving in cost. In that there are no examples of either separate or shaft driven a.c. auxiliary generators for normal supply in the present summary no conclusions can be drawn regarding their respective merits.

Although a sectionalized radial-feeder type of distribution system is still most common for auxiliaries, the low-voltage secondary network has also been developed for this service. One complete installation has been made. The network system may show a saving in first cost in new stations as well as extremely high reliability.

•

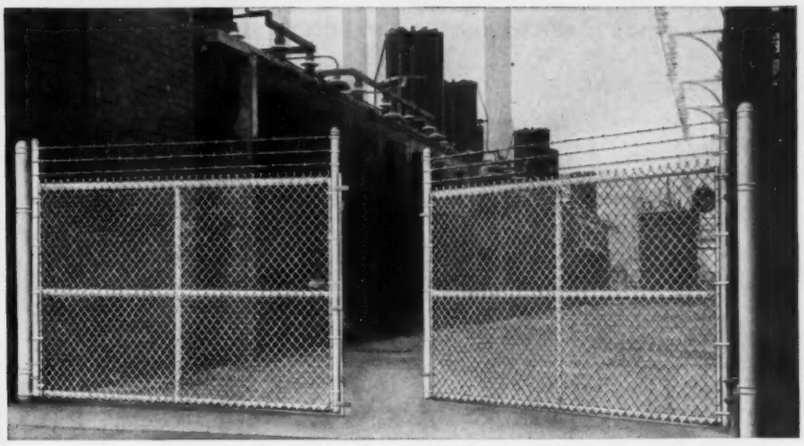
Rise in Average Price of Refrigerators Seen

On the basis of a nation-wide survey just completed, the average unit price of refrigerators sold in 1941 should be at least 10 per cent above the average for 1940, according to W. Paul Jones, head of the Philco refrigerator division.

Mr. Jones stated that while the average unit price last year was $145, advance orders and market conditions indicate that this figure will be raised to about $160. This would represent a total dollar volume for the industry of approximately $475,000,000, if the forecast of a 3,000,000-unit sale for 1941 holds good. Last year sales totaled 2,676,435 units.

PAGE FENCE

America's First Wire Fence — Since 1883



SERVICE AS LOCALIZED AS YOUR OWN POST OFFICE

★ The postal service in your town is based on training, responsibility and knowledge of local facts. So it is with Page Fence service. It is rendered by 102 factory-trained, responsible firms which have had long fence engineering experience. You can rely on them because they know local conditions and will recommend the right fence style and metal: heavily galvanized copper-bearing steel, Armco ingot iron, Alcoa aluminum, Allegheny stainless steel. Only Page can offer this choice of superior metals. Only Page can supply the stronger Winged Channel Posts. Write for "Fence Facts," and name of the nearest distributor, to PAGE FENCE ASSOCIATION, Bridgeport, Conn., Atlanta, Chicago, New York, Pittsburgh, San Francisco.

A PRODUCT OF PAGE STEEL & WIRE DIVISION—AMERICAN CHAIN & CABLE COMPANY, INC.

GUARD AGAINST CURRENT DIVERSION with STAR METER SEAL

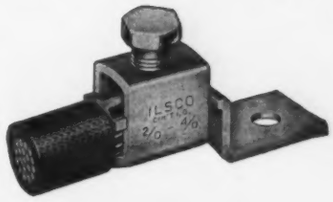
Saves many thousands of dollars annually by elimination of tampering and theft of current. Seals all types CS meters effectively and permanently. Cannot be removed without destroying or mutilating. SEND FOR SAMPLE.

The STAR PORCELAIN COMPANY

51 Muirhead Ave. Trenton, N. J.

ILSCO SOLDERLESS CONNECTORS

HAVE YOU TRIED The New Ilsco Lugs?



BUILT FOR OVERLOADS!

The new design—as passed by the Underwriters' Laboratories May 1, 1940.

MAIL COUPON TODAY

GENTLEMEN:
SEND ME new Catalog & Sample!

Name .....

Firm .....

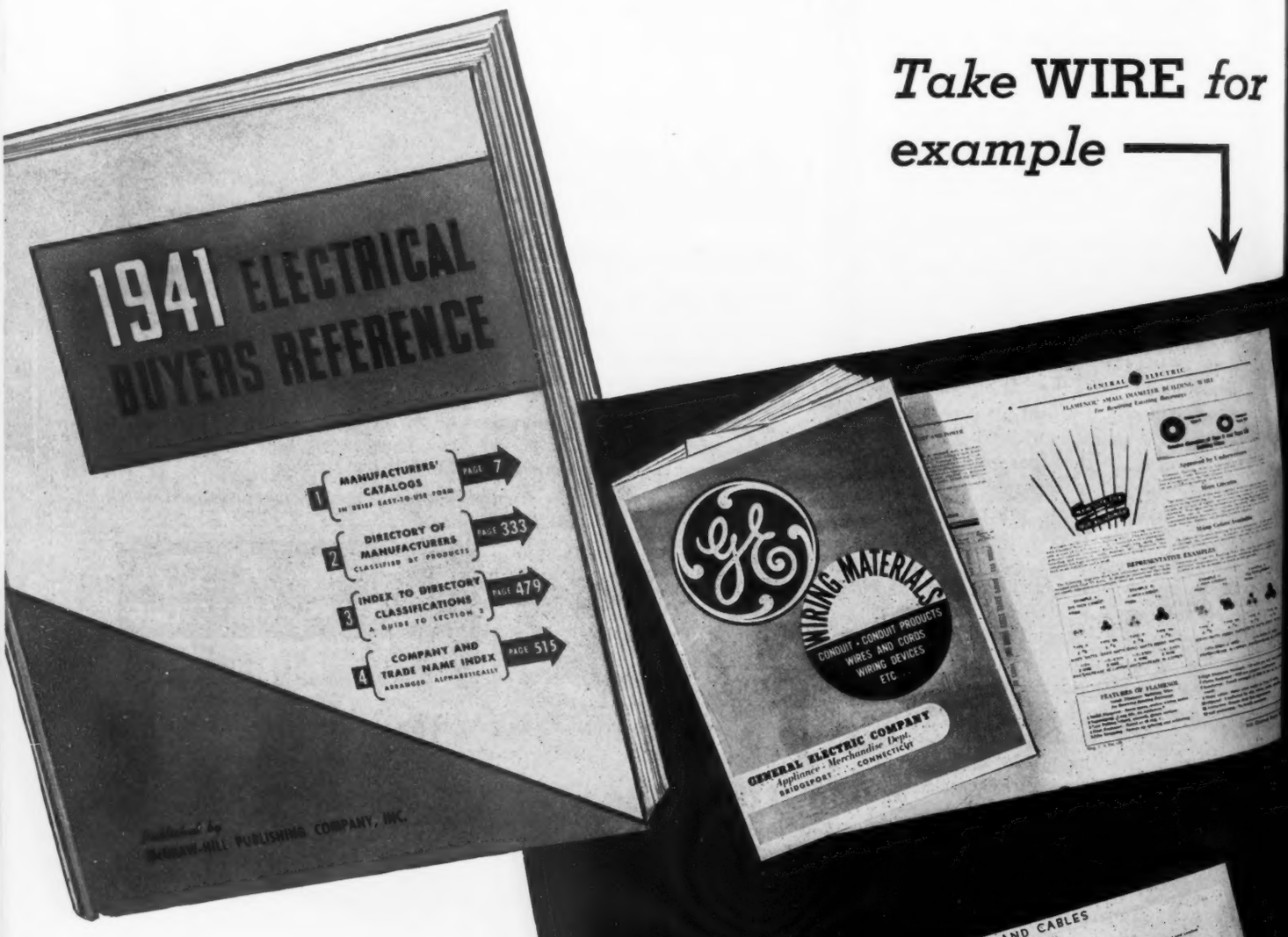
Address .....

City & State .....

ILSCO COPPER TUBE AND PRODUCTS, INC.
5629 MADISON ROAD — CIN., O.

A wealth of product data at your fingertips!

Take **WIRE** *for example*


1941 ELECTRICAL BUYERS REFERENCE
1 MANUFACTURERS' CATALOGS IN BRIEF EASY-TO-USE FORM PAGE 7
2 DIRECTORY OF MANUFACTURERS CLASSIFIED BY PRODUCTS PAGE 333
3 INDEX TO DIRECTORY CLASSIFICATIONS A GUIDE TO SECTION 2 PAGE 479
4 COMPANY AND TRADE NAME INDEX ARRANGED ALPHABETICALLY PAGE 515
Published by
McGRAW-HILL PUBLISHING COMPANY, INC.
WIRING MATERIALS
CONDUIT • CONDUIT PRODUCTS
WIRES AND CORDS
WIRING DEVICES
ETC.
GENERAL ELECTRIC COMPANY
Appliance - Merchandise Dept.
BRIDGEPORT . . . CONNECTICUT
ROEBLING
Electrical
WIRES AND CABLES

Here's a sample of the cross-referenced indexes which are a guide-and-compass to the manufacturers' catalogs . . . which make Electrical Buyers Reference the *complete* reference volume. 12 columns of listings on wire alone, broken down by types. (Bold face type refers you to manufacturers' catalogs.) This listing is supplemented by a trade and company name index.

That's why we say "Electrical Buyers Reference is your *FIRST* source of information."

● There are *over 100* pages of manufacturers' catalogs on wire alone! Solid *buying* and *specifying* information of leading companies . . . from stranding tables to addresses of local sales representatives and distributors!

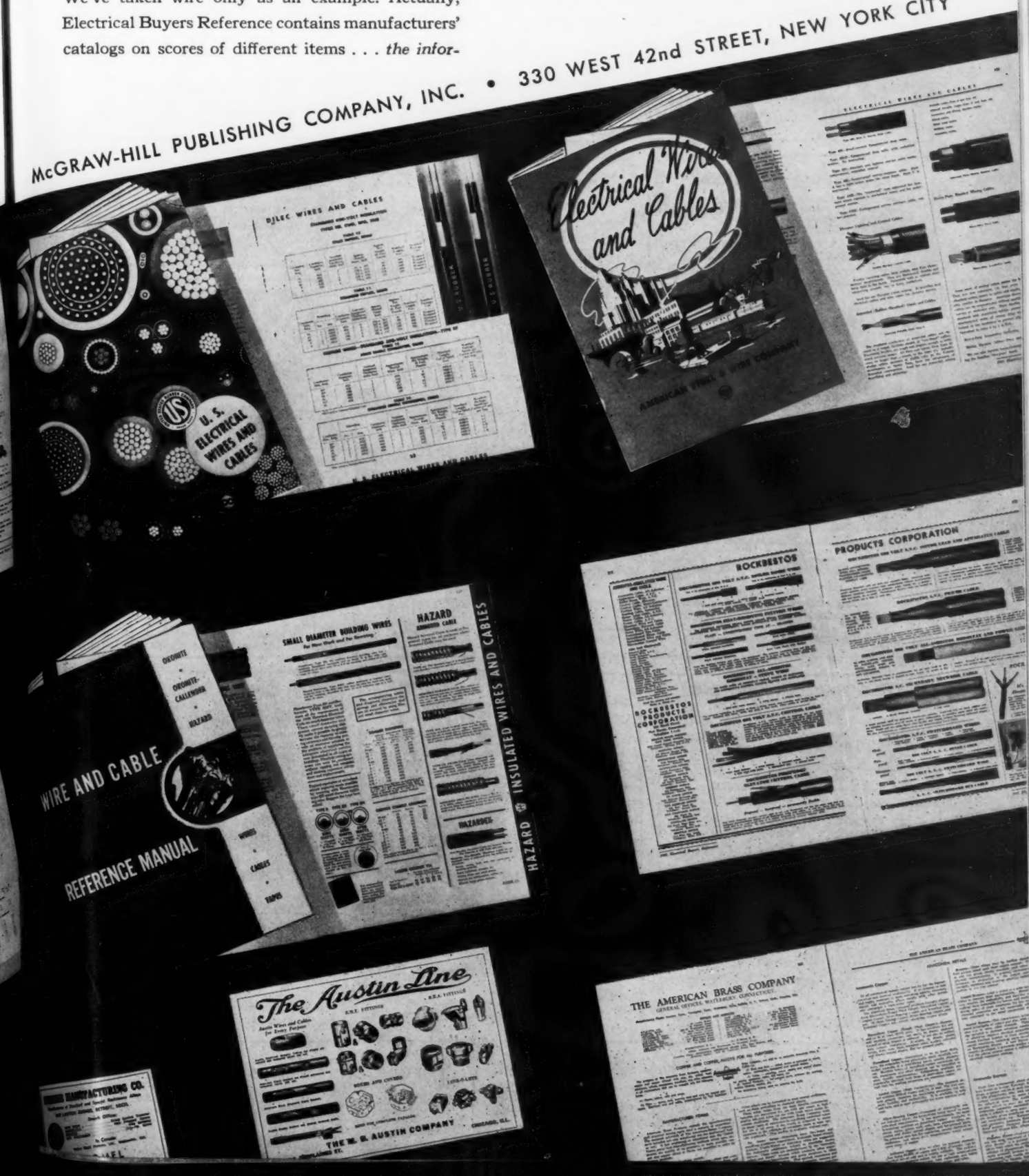
Electrical Buyers Reference compacts this information into one handy, valuable volume.

We've taken wire only as an example. Actually, Electrical Buyers Reference contains manufacturers' catalogs on scores of different items . . . *the information you need on the products of 238 individual manufacturers of electrical and allied products.*

AND, IN ADDITION, completely indexed listings of products, manufacturers, trade names, etc., for over 3500 companies!

Make Electrical Buyers Reference your FIRST Source of information!

McGRAW-HILL PUBLISHING COMPANY, INC. • 330 WEST 42nd STREET, NEW YORK CITY



PROFESSIONAL SERVICES

Consulting
Accounting
Valuations

Management
Appraisals
Construction

Designing
Testing
Financing

Inspections
Cost Analysis
Investigations

N. W. ATTERBURY & CO.

Consulting Engineers

General Engineering Service

P. O. Box 1793 Pittsburgh, Pa.

E. T. L.

TESTS

Electrical, Chemical, Mechanical, Photometric

INSPECTIONS Materials and Supplies

RESEARCH Private Labs. for Clients

Electrical Testing Laboratories, New York, N. Y.

SANDERSON & PORTER

ENGINEERS

for the

FINANCING—REORGANIZATION—
DESIGN—CONSTRUCTION—
of

INDUSTRIAL and PUBLIC UTILITIES

Chicago New York San Francisco

BARKER & WHEELER

Utility and Industrial Valuations, Design and Construction of Power Systems, Water Supplies, Sewerage and Sewage Disposal, Factory Production and Cost Control Systems.

11 Park Place, New York City
36 State Street, Albany, N. Y.

FRANK F. FOWLE & CO.

Electrical and Mechanical
ENGINEERS

35 East Wacker Drive Chicago, Ill.

SARGENT & LUNDY

ENGINEERS

140 South Dearborn St.

Chicago, Ill.

BLACK & VEATCH

Consulting Engineers

Water, Steam and Electric Power Investigations, Design, Supervision of Construction, Valuation, Tests and Laboratory Service.

4706 Broadway, Kansas City, Mo.

HOOSIER ENGINEERING COMPANY

Erecting Engineers
Transmission Lines, Substations

46 So. 5th St., Columbus, Ohio
327 South LaSalle Street, Chicago, Ill.
136 Liberty St., New York

SPOONER & MERRILL, INC.

Consulting Engineers

Design—Supervision of Construction
Reports—Examinations—Valuations

20 North Wacker Drive, Chicago, Illinois

E. J. CHENEY AND CO.

Engineers and Consultants

61 Broadway New York

WILLIAM S. LEFFLER

succeeding

CHARLES F. LACOMBE—WILLIAM S. LEFFLER
Engineers — Economists

Public Utility Management Problems
Economic Audits for Selective Load Building
Balanced Domestic Load Development
Cost Analysis—Rate Cases

30 East 42nd Street—New York

STEVENS & WOOD

Incorporated

ENGINEERS AND CONSTRUCTORS

30 Broad Street New York

HUGH L. COOPER & CO.

General Hydraulic Engineering, including the design, financing, construction and management of hydro-electric power plants.

101 Park Ave. New York

J. H. MANNING & COMPANY

ENGINEERING SERVICES

120 BROADWAY NEW YORK

FIELD BUILDING CHICAGO

STONE & WEBSTER ENGINEERING CORPORATION

Design and Construction
Reports • Examinations • Appraisals
Consulting Engineering

BOSTON • NEW YORK • CHICAGO
PITTSBURGH • SAN FRANCISCO • LOS ANGELES

DAY & ZIMMERMANN, INC.

ENGINEERS

Design - Construction - Management
Investigations and Reports

NEW YORK PHILADELPHIA Packard Building CHICAGO

DANIEL W. MEAD
F. W. SCHEIDENHELM

Consulting Engineers

Hydro-Electric Development, Dams, Water Supply, Flood Control. Engineering Problems relating to Water Rights and Water Power Law. Appraisals.

New York City, 50 Church St.

A. Y. TAYLOR AND COMPANY

Municipal and Industrial Consulting Engineers

Reports, Appraisals, Design
Supervision of Construction

2 So. Central Ave. Clayton, Mo.

ROBERT E. FOLEY

Erecting Engineer

Rural Lines—Transmission Lines
Fire Alarms—Telephone Lines

48 Griswold St. Binghamton, N. Y.

ARTHUR L. MULLERGREN

Public Utilities Consultant

Management

Fairfax Bldg. Kansas City, Mo.

THE J. G. WHITE ENGINEERING CORPORATION

Engineers — Constructors

New York, N. Y.

FORD, BACON & DAVIS, Inc.

Engineers

DESIGN • CONSTRUCTION
VALUATIONS • REPORTS

New York
Philadelphia — Washington — Cleveland — Chicago

Recording & Statistical Corp.

BILL ANALYSIS—CONSUMPTION STUDIES

THE ONE-STEP METHOD
Bill Frequency Analyzer

102 Maiden Lane New York

READERS MAY CONTACT

the consultants whose cards appear on this page with the confidence justified by the offering of these special services nationally.

70 MASTER-LIGHTS
for Better, Faster Night Repairs
High Power and Convenience to Increase the Efficiency of Your Line Crews

Type "T"
The most powerful automobile spotlight made. (Roof-type (inside Pistol Grip Control). Range one-mile. Swings in complete circle, any angle, up or down. Penetrates fog or smoke. Operates from car battery. Best construction throughout. Chrome plated, polished, aluminum handle. No gears to wear or rattle. Rust and weather-proof.

• Type T, above, is but one of the 70 Master-Lights that help give your line and repair crews adequate light to speed up emergency jobs, end outages more quickly, retain customer goodwill. Types available include worklights, searchlights, floodlights, warning lights, patrol lights, watchman's light . . . and other lights for all conditions. 30-day free trial. Send for descriptive literature.

CARPENTER MFG. CO.
Master-Light Makers
167 Sidney St.
Cambridge, Mass.

NEW ALL-PLASTIC SWITCHBOARD LAMP
FOR SINGLE HOLE PANEL MOUNTING

Type T2 Unit

The shell is molded in the same color as the lens-cap to prevent error in replacement . . . furnished with a 24 volt slide-base lamp, (.038 amp.) . . . used with a series resistor assembly for operation on voltages up to 440 . . . five different colors . . . brilliant 180 degree visibility . . . low in cost.

Write for Ten Page Catalog

GRAYBAR ELECTRIC CO.
H. R. KIRKLAND CO., Morristown, N. J.

G.C.A.
Lamp Replacers
Lamp Base Removers
Cartridge Fuse Tongs
Switch Hooks

Send for Catalogue

We have been making safety tools for 24 years

THE G. C. A. Manufacturing Co.
Pittsfield, Mass.

New Forms of Insulation Simplifies Splicing

[*Continued from page 63*]

nates the use to which that specific pad is adapted.

Thus in the completed pad we have a unitary mass of insulation with these desirable properties:

1. The pad is pliable enough to be easily wrapped in one operation around the joint, even though tapered surfaces may be involved in one or both ends of the joint.
2. The inner layer will flow and fill interstices and irregularities of the joint. The "flow" is brought about by the external pressure resulting from the stretching of the outer layer during application and from the friction tape binder applied over all.
3. The outer surface of the pad is fully cured material possessing the best possible properties.
4. The intermediate layer cures with time, ultimately resulting in a second layer of cured material.

Joints Have Added Life

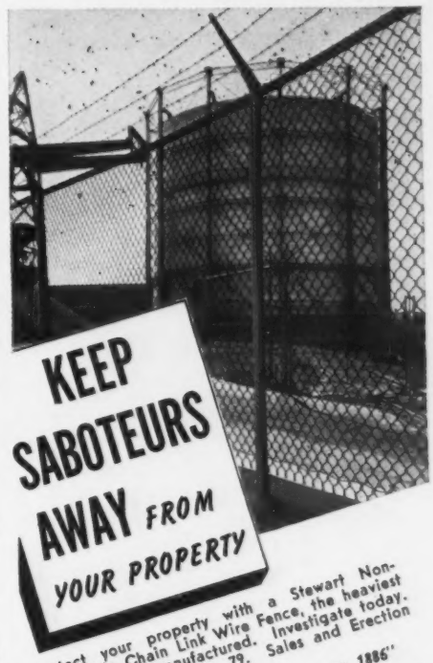
Test made on joints insulated by the pad method show the expected service life of the installation to be far superior to similar joints insulated with tape. Samples subjected to cyclic loading and immersion at the same time in water with an oil film showed no noticeable deterioration of the vulcanized or semi-vulcanized rubber. The oil slightly attacked the exposed edges of the uncured layer, but this is not considered serious since the seal provided by the layer is $1\frac{1}{2}$ in. long. Insulation resistance of these joints was measured throughout the test and was always greater than 1,000 megohms.

Electrical Tests Satisfactory

Electrical tests showed the breakdown voltage for the entire pad thickness ($\frac{3}{64}$-in. vulcanized, $\frac{3}{64}$-in. semi-vulcanized and $\frac{3}{32}$-in. uncured rubber) to be 59 kv., while the outer and middle layers ($\frac{3}{64}$-in. vulcanized and $\frac{3}{64}$-in. semi-vulcanized) showed a breakdown voltage of approximately 40 kv. Oxygen bomb tests and exposure to sunlight also gave favorable results.

While the pad described consists of all three layers made from rubber, this is not necessarily the only possible construction; variations in the composition of the layers and the use of synthetic rubber-like compounds for specific applications appear quite feasible.

The authors acknowledge the assistance of J. W. Cable of Consolidated Edison in the preparation of this article.



KEEP SABOTEURS AWAY FROM YOUR PROPERTY

Protect your property with a Stewart Non-Climbable Chain Link Wire Fence, the heaviest and strongest manufactured. Investigate today. Send for Catalog No. 79. Sales and Erection offices in principal cities.
"Fence Builders to America Since 1886"
The Stewart Iron Works Co., Inc.
866 Stewart Block
Cincinnati, Ohio

Stewart IRON and WIRE FENCES

Contains ALL the ANSWERS!

4,000 plant listings . . . personnel . . . meters connected . . . exactly the data you need on central stations for analyzing sales territories, etc., plus quick reference for individual items. Order your copy of the McGraw Central Station Directory today.

$25.00 per copy

McGRAW-HILL PUBLISHING CO. INC.
330 W. 42nd Street New York, N. Y.

Surge Absorbers Avert Transformer Burnouts

[*Continued from page 61*]

against surges? (a) Between coils, (b) between turns, (c) between high and low windings, (d) how many bushing flashovers, (e) what percentage reduction in fuse blowings?

A. No failures. Very close to 100 per cent elimination of fuse blowing.
B. Transformer subjected to surge, arced over within tank, blew cover off. Surge absorbers prevented damage to winding.
C. No coil failures. One bushing flashover. At least 99 per cent reduction in fuse blowing.
D. No failures.
E. No failures.
F. None. Have had bushing failures and burned off leads, but no failures of windings. No appreciable reduction in fuse blowing.

Absorber Failures — How many surge absorbers have themselves failed to withstand surges? How many failed for other reasons? Have you evidence of survival against direct strokes?

A. None. We have placed Ferranti-surge transformers in many places where transformers were burning out in every lightning and we have never experienced any trouble with them.
B. We have had no surge absorbers themselves fail in service; any troubles that have developed in transformers so equipped, either as to windings or bushings, have been limited to a very few where direct strokes seem to have occurred.
C, E. None failed. There is evidence of survival against direct strokes.
D. None failed. No evidence, however, of direct strokes.
F. Later design (oil-filled) are very satisfactory. Early compound-filled did not stand up. No failures. Bushing and lead failures in two cases of direct strokes.
G. Only one instance where surge absorber failed to ground. Two suffered broken bushings either from mechanical damage or temperature changes. No actual evidence of direct strokes.

Absorber Loss—What is your attitude toward the losses introduced by the surge absorber?

A. The losses are entirely negligible.
C. Losses negligible.
E. Losses are small.

Comparative Effectiveness — What is your general attitude toward the effectiveness of the surge absorber as contrasted with alternative forms of surge protection?

A. No experience with Petersen coils, gaps, non-resonating transformers or other wave-flatteners. Undoubtedly there are many good arresters, but an arrester is of no use whatever unless a low resistance is available. The beauty of surge absorbers is that good grounds are not necessary.
B. Experience indicates the necessity for ground resistances below 25 ohms if arresters are to be used.
D, G. Surge absorbers more effective where good grounds are hard to get.
E. Surge absorbers superior to arresters and deionizing gaps.
F. Consider absorbers more effective than arresters.

Economy

Do you feel that the expenditure for the surge absorber is justified by the results which it gives?

A. Yes.
C. Yes.
D. Yes, surge absorbers cost about the same as arresters.
E. Yes.
F. Yes.
G. Yes.

Maximum Availability Aim of Switch-House Design

[*Continued from page 79*]

breaker compartment door or taken to the feeder grounding cubicle. But before the grounding switch in this cubicle can be operated the associated breaker 2329 and its disconnect switches must be opened in the same manner as for 2330. With both keys 2329-B and 2330-B in his possession the operator may release the ground switch in the feeder grounding cubicle.

Operation of the feeder grounding switch releases the latch on the door, allowing access to the removable link, which entirely disconnects feeder grounding cubicle from its associated breakers. However, before access can be had to terminals for bifurcating the cable a special key is required. This key must be obtained from the operator in charge. A warning plate instructs the operator to test the feeder for backfeed before grounding or paralleling the cable.

•

Repayment Made on Loans by REA Borrowers

Seventy REA borrowers in 25 states made advance payments of principal totaling $347,246, Harry Slattery, Administrator of Rural Electrification, has announced. States represented by these systems are Arizona, California, Colorado, Delaware, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Mexico, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Texas, Virginia and Wisconsin.

The largest total for any one state was $47,254 for Minnesota.

SEARCHLIGHT SECTION

(Classified Advertising)

Employment : : Equipment

Business : : Used or Resale

"Opportunities"

UNDISPLAYED RATE

10 CENTS A WORD. MINIMUM CHARGE $2.00

Positions Wanted (full or part time salaried employment only), ½ the above rates payable in advance.

Box Numbers—Care of publication New York, Chicago or San Francisco offices count as 10 words.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

DISPLAYED RATE

Individual Spaces with border rules for prominent display of advertisements.

The advertising rate is $6.50 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on one column. 3 columns—30 inches—to a page.

POSITION VACANT

ELECTRICAL DISTRIBUTION ENGINEER wanted, E. E. graduate, age 28-35, analytical, aggressive, about 5 years experience. Permanent. Headquarters New York. Salary commensurate with experience and ability. P-875, Electrical World, 330 W. 42nd St., New York, N. Y.

EMPLOYMENT SERVICE

SALARIED POSITIONS, $2,500 to $25,000. This thoroughly organized advertising service of 31 years' recognized standing and reputation carries on preliminary negotiations for positions of the calibre indicated above, through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If your salary has been $2,500 or more, send only name and address for details. R. W. Bixby, Inc., 262 Delward Bldg., Buffalo, N. Y.

Executives and Technical Men. Qualified candidate desiring $2,500 to $20,000 positions may contact employers through our confidential services, established 25 years. The National Business Bourse, 20 W. Jackson Blvd., Chicago.

POSITIONS WANTED

(See also "Selling Opportunities Wanted")

MAN age 36. With 16 years experience in Hydro Power Plant Engineering. 5 years with U. S. Government. Wants position as Engineer or assistant to Engineer in Municipal or Power Company or Manufacturing Company. Will take job anywhere. It must be regular work. PW-865, Electrical World, 330 W. 42nd St., New York, N. Y.

OPERATING MANAGER: Capable and able to take complete charge of system:—generation, distribution, rates, accounting, and general engineering. 13 years of diversified electric and water experience. E.E. graduate, G.E. Test Course. Now employed. PW-867, Electrical World, 520 N. Michigan Ave., Chicago, Ill.

ELECTRIC UTILITY EXECUTIVE and ENGINEER with diversified, balanced operating experience production, transmission distribution, design, construction, sales, purchasing, public relations. Age 38. Excellent record employee relations. Fully capable as executive assistant, supervisor general or specific operations, or utility engineer with financial institution. Now employed. PW-869, Electrical World, 520 N. Michigan Ave., Chicago, Ill.

(Continued on the opposite page)